



THE THREE AGRICULTURAL INPUT **MEGA-MERGERS:**

Grim reapers of South Africa's food and farming systems

April 2017



african centre for biodiversity

www.acbio.org.za

Contents

Abbreviations	3
About this paper	4
Key findings	4
Introduction	6
Global mega-mergers in the agricultural sector: background	7
Concentration reaching historical proportions in the agricultural sector	7
The two previous waves of agri mega-mergers	7
A third wave of global agro-mergers?	8
Concentration in research and development	9
Concentration in the fertiliser sector	11
Farming equipment and big data	13
Global commercial seed and agrochemical markets	17
Global commercial seed markets	17
Global agrochemical markets	19
South African commercial seed and agrochemical markets	20
South African commercial seed markets	20
African and South African agrochemicals markets	24
Under scrutiny: the merging of the Big Six	26
The ChemChina offer to acquire Syngenta	26
Syngenta	26
ChemChina	27
Where does the transaction stand now?	28
The Dow Chemical-DuPont merger	29
Dow Chemical	29
DuPont	30
Where does the transaction stand now?	31
The Bayer-Monsanto merger	32
What does control by three COMPANIES, rather than six, really mean?	33
What are the drivers of these mergers?	33
Increasing profit margins for shareholders?	34
Seeking out innovation and research synergies?	35
Pushing for global responses to global issues...	36
...or getting ready for the next (agricultural) world order...	37
...that will be dominated by the financial world?	38
Implications of the mega-mergers on South Africa	40
Innovation in the sector	40
Commodity prices	40
Impacts on commercial and smallholder farmers	41
Food sovereignty	42
Conclusion	43
References	44



On 7 April 2015 the African Centre for Biosafety officially changed its name to the African Centre for Biodiversity (ACB). This name change was agreed to by consultation within the ACB, to reflect the expanded scope of our work over the past few years. All ACB publications prior to this date will remain under our old name of African Centre for Biosafety and should continue to be referenced as such.

We remain committed to dismantling inequalities in the food and agriculture systems in Africa and to our belief in peoples' rights to healthy and culturally appropriate food, produced through ecologically sound and sustainable methods, and to define their own food and agriculture systems.

©The African Centre for Biodiversity

www.acbio.org.za

PO Box 29170, Melville 2109, Johannesburg, South Africa. Tel: +27 (0)11 486 1156

Copy editor: Liz Sparg

Infographics: Lettie Nkobi

Design and layout: Adam Rumball, Sharkbuoys Designs, Johannesburg

Acknowledgements

The African Centre for Biodiversity (ACB) acknowledges the generous support of Bread for the World and the Swiss Foundation.

We are grateful to Sasha Mentz-Lagrange for her efforts in researching and writing this paper and to Stephen Greenberg and Mariam Mayet of the ACB, as well as Stefanie Swanepoel for their contributions.

Abbreviations

ACB	African Centre for Biodiversity
ACCC	Australia's Competition and Consumer Commission
ARC	Agricultural Research Council
AVCASA	Association of Veterinary and Crop Associations of South Africa
Canpotex	Canadian Potash Exporters
CCSA	Competition Commission of South Africa
CIMMYT	International Maize and Wheat Improvement Center
CR4	Four-firm concentration ratio rule
CRISPR	Clustered Regularly Interspersed Short Palindromic Repeats
DAFF	Department of Agriculture, Forestry and Fisheries
DUCA	Data Use and Compensation Agreement
ETC Group	Action group on Erosion, Technology and Concentration
EU	European Union
FMA	Financial Markets Advisory
GEMAA	Generic Event Marketability and Access Agreement
GMO	Genetically Modified organism
IPES-Food	International Panel of Experts on Sustainable Food Systems
MNC	Multinational Corporation
R&D	Research and Development
SAAMA	South African Agricultural Machinery Association
SANSOR	South African National Seed Organisation
SPC	Supplementary Protection Certificates

About this paper

This paper investigates the global context of three mega agri-mergers currently underway in the seed and agrochemical sectors.¹

This year we will know whether regulators around the world will permit United States (US) giants Dow Chemical and DuPont to merge, China National Chemical Corporation (ChemChina) to acquire Syngenta and Bayer to acquire Monsanto. The research outlines seminal trends in concentration throughout the agricultural value chain and shows how, should these mergers and acquisitions be approved, an oligopoly will end up controlling the world's food systems. This paper argues that such concentration goes beyond pure market share and competition issues and is essentially about power and food sovereignty. It is addressed to the South African public at large and especially the Competition Commission of South Africa (CCSA), which will make critical rulings in the months to come. These findings are also pertinent in the context of rising concerns over general consolidation trends in South Africa's economy. In the 2017 State of the Nation address, the Presidency identified economic concentration as a social concern and has indicated intentions to amend the Competition Act in order to tackle this (News24, 2017).

This paper complements an earlier paper produced by the ACB titled "The Bayer-Monsanto merger: Implications for South Africa's agricultural future and its smallholder farmers",² which was published in February 2017 and which essentially focuses on the Bayer-Monsanto merger. In the current paper, the research focuses on global trends in the agricultural sector, with a specific emphasis on the ChemChina-Syngenta and Dow-DuPont transactions. The earlier Bayer-Monsanto paper also focuses on the consequences of such a merger for South African farmers. These consequences are equally applicable to the ChemChina-Syngenta and Dow-DuPont transactions and the reader is referred to the Bayer-Monsanto report for additional insights.

Key findings

- Current levels of concentration in the global seed and agrochemical markets already exceed what economists have traditionally deemed to be sound competitive markets. The "four-firm" concentration ratio (CR₄) rule (that is, the combined market share of the four largest firms in a given industry) assumes an oligopoly if four firms together hold 40% of the market. Today the world's three leading seed and agrochemical companies are beyond this threshold: the top three firms already control 55% of the commercial seed market (#1 Monsanto, #2 DuPont Pioneer and #3 Syngenta) and 51% of the agrochemicals market (#1 Syngenta, #2 Bayer Crop Science and #3 BASF) (ETC Group, 2015). And here is what the bigger picture looks like: the "Big Six" mega seed and chemical crop players, (namely, BASF, Bayer, Dow, DuPont, Monsanto and Syngenta) together control 75% of the global agrochemical market, 63% of the commercial seed market and over 75% of all private sector research and development (R&D) in the sector (ETC Group, 2015:4).
- These industries have followed a concentration trend since the 1970s and today we are on the cusp of a third round of global mergers in the seed and agrochemical sector. If these deals go through, the markets will be dominated by just three behemoths. In the pipeline are three mega-mergers. Leading the pack in terms of its market capitalisation value is the "merger of equals" between US giants Dow Chemical and Du Pont, which roughly equates to US\$130 billion. This transaction in the making is followed in value by the acquisition of US Monsanto by German Bayer, worth an estimated US\$57 billion and then by the acquisition of Swiss Syngenta by Chinese state-owned ChemChina, a transaction valued at US\$43 billion.
- The Dow-DuPont and ChemChina-Syngenta deals were announced first and

1. Agrochemicals incorporates both crop protection and synthetic fertilisers, but for this paper we are using the term "agrochemicals" interchangeably with "crop protection", since this is the most common use of the term.

2. The report can be found at <http://acbio.org.za/wp-content/uploads/2017/02/Bayer-Monsanto-report.pdf>.

are in the final stages of the regulatory process; an in-depth merger probe is currently underway for the ChemChina-Syngenta transaction in Europe and in the US. The European Union (EU) regulator recently approved the Dow-DuPont merger (Reuters 2017c). The verdict from regulators in the United States, Brazil, China, Australia, Canada and South Africa is still pending. According to Diana Moss, president of the American Antitrust Institute non-profit group “The EU approval may be a sign that U.S. regulators would follow suit because the agencies have traditionally coordinated on reviews and remedies for large multinational mergers”. The EU will announce the outcome of the ChemChina-Syngenta deal in April 2017. At the time of writing, the Bayer-Monsanto merger is still being prepared for filing with the EU regulator but it has submitted the merger application to the Competition Commission of South Africa (CCSA).

- A lot of ink has been shed by industry analysts on the likelihood of these deals going through. The emerging consensus is that the ChemChina-Syngenta deal will most probably encounter the fewest hurdles (Seeking Alpha, 2016), whereas the other two mergers will be more problematic.
- The dominating narrative put forward by the merging parties is that by joining forces they can more efficiently scale (and rationalise) their R&D budgets, henceforth bolstering their capacity to innovate. This is a moot point, as regulators throughout the world have raised strong concerns about the mergers posing a risk of declining research, and decreasing innovative products will lead to a drop in crop yields (EU Competition Commission, 2016).
- These mergers are indisputably driven by a multitude of other factors, such as the need by these companies to secure and expand into new markets – and to keep shareholders happy.
- But there is more to even this than meets eye. What is at stake goes beyond market shares and concentration; the underlying issues have implications for food systems and are about power and control, and need to be analysed in the light of other technological trends, for example, digitalisation of agriculture and the role played by the agricultural machinery sector in the “big data” game.
- A transition from a “Big Six” to a “Big Three” – and eventually maybe just a “Big One”? – will squeeze global productive and food systems, placing them on a narrow technological path, characterised by a dependence on proprietary seed, including and especially genetically modified (GM) seed and agrochemical inputs. Concentration from six to three puts the corporations firmly on the path of “too big to fail”, and we can anticipate public sector bailouts should they run into problems in the future. A reduction in the number of providers will entail less choice in agricultural inputs and less diversity in the food produced, as the diversity of crops grown is bound to diminish drastically. This would entail further entrenching the tendency towards highly processed, standardised, input-intensive staple crop varieties, to the detriment of traditional foods, resulting in the loss of nutrients and agricultural diversity (IPES-Food, 2016). Ultimately, the issue at stake is that of food sovereignty and of appropriate and sustainable food systems.
- This is a critical aspect of the debate that competition regulators worldwide totally overlook, because public interest issues are only relevant when tied with the issue of competition. But consolidation in the seed and agrochemical sectors is about control of resources and restructuring the agriculture sector, not only about market shares and narrow competition issues.
- The CCSA has already ruled in favour of the ChemChina acquisition of Syngenta (CCSA, 2016) and has completed its investigation of the Dow Chemical-DuPont merger,³ for which it is awaiting remedies by the parties before it concludes on the matter.

3. Telephonic interview, Gilberto Biaciuna: CCSA's lead investigator for the Dow-DuPont merger application, 26 January 2017

Introduction

Today the financial and seed and agrochemical news outlets are pulsing with speculative analysis on whether the “Big Three” mergers in the seed and agrochemicals sector (ChemChina-Syngenta; Dow-DuPont; and Bayer-Monsanto) will get the go ahead in 2017. But today, the top three leaders already jointly own over half the US\$39 billion (ETC Group, 2015) patented global seed market (55% is controlled by #1 Monsanto, #2 DuPont Pioneer and #3 Syngenta) and of the US\$54 billion (ETC Group, 2015) to US\$60 billion (News Agro) agrochemical market⁴ (51% controlled by #1 Syngenta, #2 Bayer CropScience and #3 BASF) (ETC Group, 2015:5). Concentration in the sector has never known such proportions.

To bring some historical perspective to the current mega-mergers – all of which were announced during 2015/2016 and are expecting regulatory approval during 2017/2018 – we need to remember that the consolidation in the seed and agrochemical sector dates back four decades. The first wave of mergers in the agricultural sector took place in the late 1970s to mid-1980s. A second wave of consolidation happened in the 1990s; at the time regulatory bodies were not expecting the possibility of seed and agrochemical companies merging. The current discussions between the six seed and agrochemical “majors” offer the prospect of a third wave of mega-mergers in these sectors. Some analysts anticipate a future fourth round of mergers, premised on the fact that in the present time, “GenChems⁵ and DataMachs converge, technologically, in the clouds” (ETC Group, 2016a:5) as we will explain in this paper. This implies that – possibly as soon as 2025 – mergers between the seed/agrochemical giants and the farm machinery sector could happen.

Therefore, the buzz around the potential global market control that these three looming mergers would entail clouds a much bigger issue. It is about the changing face of

the industry as a whole, deeply transforming the value chain “from crop and livestock genomics to farm machinery and insurance”, which is worth close to US\$500 billion (ETC Group, 2016a:6). A seminal development in the sector relates to the digitalisation of agricultural technologies, an initiative spearheaded by Deere & Company (with John Deere as the leading brand name) – an American corporation that is the world’s biggest manufacturer of agricultural, construction, and forestry machinery. This digitalisation of agricultural technologies fervour involves all the merging firms, except for ChemChina, but includes BASF, one of the Big Six that has been left out of the merger mania for now, and which will have to acquire or be acquired. The happenings in the machinery sector, led by Deere & Co (#1 with 23.1% of the global market value in 2014), CNH (#2 with 1.3%), Kubota (#3 with 8.8%) and AGCO (#4 with 8.5%) (ETC Group, 2016b) are very much under the radar as these are not embedded in the same controversy as the seed and agrochemical giants are. Yet, over the past four years, the sector has expanded its control and reach over digital technologies, whilst entering into several deals with the agricultural input sectors.

It is with this big picture in mind that regulators in South Africa need to appraise the deals currently under review. What do the mergers mean for South Africa’s large-scale commercial farmers, as well as small-scale farmers trying to establish a foothold in the market? Experts assigned to reviewing each merger cannot possibly consider them in an isolated case-by-case manner and solely as an economic phenomenon. At the time of writing, the Competition Commission of South Africa (CCSA) had approved the acquisition of Syngenta by ChemChina (operating through ADAMA South Africa) and the Dow Chemical-DuPont merger was under review. The Bayer-Monsanto merger was filed with the CCSA on 7 February 2017. The Bayer-Monsanto merger is considered an intermediate merger and investigation has to be concluded within 60 days. Several crucial questions remain: Will the CCSA

4. A very recent estimate values this market at US\$214.2 billion in 2015 (Markets & Markets, 2016), a figure that is difficult to verify but which implies the market has more than tripled in three years, a growth that is most certainly improbable.
5. The term coined by the ETC Group to refer to the seed/agrochemical MNCs.

reconsider the ChemChina-Syngenta deal and consider all three mergers together? Will it also consider what is happening between John Deere and these firms at a global level and the implications for our domestic markets and food sovereignty? Are our decision makers aware of how farmers and consumers alike are faced with the long-term prospects of less diverse choices in the inputs and the food they buy?⁶

These deals are considered in a detached manner from any understanding of their political dimensions. The approach adopted by competition authorities is that, although global trends are taken into consideration when ruling on a merger application, ultimately the Commission's decision is informed by the state of competition at the time of the application. From a purely economic perspective, the CCSA contends that it cannot indulge in prospective considerations and pre-empt all potential merger applications. Deals that are de facto happening at the same time (at least in the span of two years) cannot also be reviewed in synchronicity, as these simply haven't happened (yet). In other words, the ChemChina-Syngenta transaction, which was first filed with the commission and approved, will inform the Commission's decision with regards to the Dow-DuPont application. Assuming this merger is approved in South Africa (and globally, which is not entirely certain), then the Commission will, in turn, look at how this consolidation affects the market when it considers the Bayer-Monsanto merger application.⁷ The first come, first served rule applies here and overshadows what is really at stake: hugely increased corporate power and control of the food value chain. Conversely, as underlined by analysts recently, should any of the mergers be turned down, this would also set a precedent and influence the outcome of the next merger review; in other words, should regulators prohibit the Dow-DuPont merger, the Bayer-Monsanto

merger is also unlikely to get past European regulators (New York Post, 2017b). And the CCSA's rulings hold significant power over the global outcome of these merger deals.

The paper initially offers some background to the mega-mergers and looks beyond the three mergers, at what else is happening in the global agricultural sector that needs to be taken into account when critical regulatory decisions are being made. It reviews the state of the global (and South African) seed and agrochemical sectors, and looks at the merging firms in more detail. It then attempts to analyse and unpack the meaning of these potential transactions in global terms, but especially with a view to understanding their impact on South African society and agricultural sector.

Global mega-mergers in the agricultural sector: background

Concentration reaching historical proportions in the agricultural sector

Etymology of "concentration": from the Latin "com" (with, together) and "centrum" (centre). The meaning, "to bring or come to a common centre," dates back to the 1630s.⁸

Where is this "common centre" taking us? What will it look like?

The two previous waves of agri mega-mergers

The commercial seed markets have, over the past four decades, morphed from a base of small-scale/family owned businesses to large multinational corporations (MNCs) globally, integrating the seed value chain

6. We acknowledge that these corporate players may release a wide array of new products, seemingly offering greater choice to farmers and consumers; however our contention is that these will remain constrained to specific technological pathways, which, in turn, steer our food systems down a narrowed (technological and high-input) avenue. The issue is, therefore, about quality, diversity and free will over choices.
7. Telephonic interview, Gilberto Biacuana, South Africa Competition Commission's lead investigator for the Dow-DuPont merger application, 26 January 2017
8. http://www.etymonline.com/index.php?term=concentrate&allowed_in_frame=0

(plant breeding/production/marketing/distribution) with the agrochemical sector. From the late 1970s up to the mid-1980s, commercial seed markets experienced a first wave of concentration, essentially in the hands of the petro-chemical sector, which then essentially owned the pharmaceutical industry. Royal Dutch Shell (then the biggest holder of seed varieties in the world) and others in the sector saw a great retail opportunity with owning seeds.⁹

Subsequently, and very attributable to the decline in the agrochemical industry since the 1970s, the chemical supply market (needing expansion) and seed market (more profitable) became further intertwined in the 1990s, notably through widespread mergers and acquisitions (Bryant et al., 2016). The drivers of this concentration are multi-pronged and extensively discussed in the literature. Fuglie et al. (2012) contend that the emergence of biotechnology was the main driver of acquisitions in the crop (and animal) breeding sector, as accessing bigger markets was critical to share the costs associated with meeting regulatory approval of new biotechnologies. In the agrochemical sector, an important way for firms to meet stricter regulatory requirements as a result of rising health, safety and environmental concerns, was to get bigger. But the drive for expansion into the seed market was also to overcome the slowdown in the agrochemical sector, at a time when full patent protections of commercialised pipeline transgenic seeds seemed guaranteed (Howard, 2015). And so these sectors merged.

This is how the seed and agrochemical sectors converged as MNCs hedged their bets on the nascent transgenic herbicide-tolerant seeds (GM seeds were introduced commercially in 1995), and seed companies thus became a delivery vehicle for the patented traits held in the chemical sector (Howard, 2015). In a way this so-called

revolutionary technology fooled regulators, who wouldn't believe that "proprietary chemical-and-seed packages" (ETC Group, 2015:10) could circumvent their vigilance. What happened is that through a wide range of mergers, agrochemical companies not only expanded their markets, they also acquired seed distribution resources (Howard, 2009). The number of acquisitions was phenomenal, with the top ten seed firms fully absorbing nearly two hundred seed companies and purchasing equity stakes in dozens more between 1996 and 2013 (Howard, 2016:112). This phenomenon was, in retrospect, the second wave of mega-mergers in the seed and agrochemical sector.¹⁰

A third wave of global agro-mergers?

Today, we say the global seed and agrochemical sector is concentrated, because it is essentially dominated by what are commonly labelled the "Big Six"¹¹: BASF, Bayer, Dow, DuPont, Monsanto and Syngenta. Together, in 2013 these firms controlled 75% of the global agrochemical market, 63% of the commercial seed market and over 75% of all private sector R&D in the sector (ETC Group, 2015:4).

But importantly, as pointed out by Fuglie et al. (2012), this concentration is not limited to the seed and agrochemical sector; the animal health, animal genetics/breeding¹² and farm machinery sectors are equally dominated by the largest four players active in these respective sectors. They show how "by 2009, the largest four firms in each of these industries accounted for at least 50% of global market sales" (2012:1).

It is critical to get a good understanding of the historical precedents underpinning the current looming mega-mergers. This consolidation timeline will help in understanding the big picture and how, in fact, the approval of this third wave of mergers by regulators would create fertile

9. Telephonic interview, Pat Mooney, Executive Director: ETC Group, 30 January 2017

10. Ibid.

11. The ETC Group (2016b) recently coined a new term to refer to these: the GenChem, from the combination of "genomics" and "chemical". As we shall see, all these firms are also very involved in the "big data game"; genomics is biotechnology – but combines with big data in the new digital biotech.

12. It is important to also give consideration to the concentration trends in the animal genetics sector in a world that is increasingly hungry for meat. Research has underlined the increasing concentration in developed countries of poultry, pig and cattle breeding programmes in the hands of a few multinational companies, (Nimbkar and Arendonk 2010), for a market that is projected to reach USD 5.50 billion by 2021 (Markets and Markets, 2017).

ground for a fourth global megamerger, foreseeable in the next decade¹³ as discussed below. But before getting there, we should recognise that this concentration phenomenon encompasses other parts of agricultural input supply, including R&D, fertiliser, and farm machinery and equipment.

Concentration in research and development

In the same way that the seed/agrochemical industry became more concentrated in the 1970s, private agricultural R&D grew rapidly, far outpacing R&D in the public sector, which stagnated (Fernandez-Cornejo and Schimmelpfening, 2004).

However, over the past decade, there has been a clear drop in private sector R&D spending, too, which has translated into a sharp decrease in new pesticide active ingredients launched (Xie, 2015). Analysts see this as being key to the wave of consolidation and concentration in the sector during that time (Bryant et al., 2016). This is explained by the fact that concentration and patents interact as substitutes (Schimmelpfening, Pray and Brennan, 2004): the more the seed/agrochemical market becomes concentrated, the less competition there is in a market that is controlled by fewer players. This configuration implies that there is a lesser need for patents, as the number of players that firms need to protect their intellectual property from are fewer. But conversely, more concentration could also entail fewer patents as a result of fewer research results to protect. Economies of scale achieved through a merger also allegedly account for these budget cuts; for instance as part of its restructuring (and in preparation for the merger), Monsanto has started to cut back on its R&D staff comprising 4,500 people across 40 countries (Agrow, 2016b). The sign off of the Dow/Dupont merger by the EU regulator has just illustrated the correlation between concentration and the contraction of R&D. Indeed, the EU's approval required divestments by DuPont

in its pesticides business, including its global R&D organization (Reuters 2017c).

Today, the share of private R&D in biotechnology development performed by the largest seed and agrochemical firms is comparatively even larger than their share of sales (Fuglie et al., 2012). The dominance of the corporate sector in agricultural R&D has never been as strong and far-reaching as it is now (ETC Group, 2015). In 2015, the six largest companies accounted for more than 80% of crop field trials for regulatory releases of GM seed in the United States and they also controlled the bulk of private-sector agricultural biotechnology patent issues in the United States (King and Schimmelpfening, n.d.).¹⁴

The Big Six firms are fully vertically integrated and house tremendous R&D capacity. It is estimated that these firms allocate an average of over 10% of sales to R&D (Agrow, 2016b). Table 1 captures the firms' R&D budgets and strategies. All in all, the Big Six's combined R&D budgets in seed and agrochemicals is over US\$6 billion, making it the most important R&D investment in the whole of the agricultural value chain (Agrow, 2016b).

An important distinction needs to be made between new products that a seed/agrochemical firm launches and a new chemical. In 2016, Dow, for instance, launched a new chemical (isoclast active), currently the sole member of a new chemical class of insecticides, the sulfoximines (Dow AgroSciences, 2016), which is the active ingredient used in its new systemic insecticide called "Closer", one of the firm's flagship products (in South Africa). As reported by one of its business development managers in South Africa, the release of new chemicals is not a frequent occurrence and it will be several years before Dow AgroSciences will release another new chemical. On the other hand, the firm is looking at registering new products this

13. Telephonic interview, Pat Mooney, Executive Director: ETC Group, 30 January 2017

14. Other figures worth noting (global values in 2010): In crop seed and biotechnology, eight seed-biotechnology companies accounted for 76% of all R&D spending by this industry. In agricultural chemicals, five companies (each with over US\$2 billion sales) were responsible for over 74% of the R&D in this sector (Fuglie et al., 2012).

Table 1: R&D expenditure of the Big Six, performance and claimed value of the R&D breakthroughs at peak sales¹⁵

Big Six	R&D budget (2015) US\$	Strategy and performance	Claimed value of R&D pipeline at peak sales
Monsanto	US\$1.58bn	Focus mainly on seed and traits since it decided to focus on seed company and to cut back on crop protection R&D	Access to a market over US\$20bn
Syngenta	US\$1.36bn	10 new active ingredients planned for 2014–2024	US\$4bn
Bayer	US\$1.209bn	1–2 new products launched per annum, on average	€5bn peak sales value by 2010
DuPont	US\$1.04bn	Aims to deliver one innovative crop protection product per annum, on average	Seeds and traits: US\$2.1–2.7bn Crop protection: US\$400m –2bn
BASF	US\$740m	An estimated US\$170m expenditure for plant science	US\$3.3bn which includes US\$2.2bn for products up to 2020 and US\$1.1 for products up to 2025
Dow-Chemical	US\$379m ¹⁶	1 product launched per annum between 2010 and 2015	£1bn
ChemChina	Unspecified – ADAMA mentions US\$93m on registration activities (annual report) 1% of sales spent on R&D		
Total (excl. ChemChina)	US\$6,3bn		

Source: Reproduced from Agrow 2016b and based on own calculations for Dow

year¹⁷ – various chemical products for different uses containing isoclast active.

Importantly, the MNCs have expanded their R&D facilities around the world and they have the capacity to develop and adapt new technologies to local conditions. In Africa (but also in other countries in the global South) they operate their research networks in partnership with national research institutions, which makes it easier for them to meet national regulatory requirements

(Fuglie et al., 2012). The main role of the MNCs' subsidiaries in Africa, for instance – beyond managing the distribution of products in a given country – is to dedicate research to scientifically testing the toxicology of new products locally, under controlled conditions and extensively in the field (Kirsten et al., 2010), so as to acquire registration and certification before being released on the market.¹⁸ There is also ample evidence that these firms hold considerable influence in shaping and influencing

15. Note these R&D figures are for the firms as a whole and not for the divisional figures for R&D specific to agriculture.

16. Figure calculated based on the figure of 3.3% of sales spent on R&D in 2015 (Statista, 2015), which was US\$11.5 billion (Dow, 2015)

17. Telephonic interview, Benjamin Cloete, Business Development Manager – Northern Region: AgroSciences Southern Africa (Pty) Ltd., 30 January 2017

18. Telephonic interview, Benjamin Cloete, Business Development Manager – Northern Region: AgroSciences Southern Africa, 30 January 2017

biosafety legislation (notably through the activities of “developmental” arms such as USAID), a pre-requisite to allowing the entry and cultivation of any genetically engineered plant material (ACB, 2016a).

South African regulators know that economists strongly caution that when four firms control more than 40% market share, there’s a higher risk of price control (Howard, 2015), a greater risk of anticompetitive behaviour, which in turn undermines research and innovation (ETC Group, 2015). If we look at a picture of the combined seed/agrochemical/farm implement sectors, a three-firm concentration far exceeds that market (ETC Group, 2015). If all the mega-mergers are approved, just three main players will control the R&D base in these sectors (see Figure 3).

This is a critical aspect of the debate; research and innovation in the seed and agrochemical sectors will become even more locked into a technological pathway driven by corporate profitability and shareholder returns as more resources are channelled into a high-input, technology dependent production system. This path dependency is strongly characterised by specialisation, especially in terms of the food crops that are researched and improved (IPES-Food, 2016), resulting in a focus on a few commercial crops and a limitation of alternatives. What farmers need are holistic approaches to pest management and improved high yielding seeds, which they can save and replant without paying royalties. Farmers (and our ecosystems) also need a diversity of crops – as a means to diffuse risk in challenging farming conditions – but also to ensure a sound nutritional base. The stronger market power of a few firms and decline in public sector research as a consequence of concentration means that farmers may pay higher prices for purchased inputs, as the firms will carry over the cost of their R&D investments into the products that they sell (Fuglie et al., 2012). But the economic repercussions of concentration play out in an even more insidious manner for farmers. As explained by the United Nations Special Rapporteur on the Right to Food, smallholder farmers, who are traditionally the least competitive players in the food value chain, “may be relegated to low-value segments of the market or driven out of

business altogether in situations where the buyer uses its dominant position to push down farm gate prices” (De Schutter, 2010: 4).

A new age of highly technologised agriculture

It is beyond the scope of this paper to capture the depth and spectrum of what is happening in terms of technological innovations in the agricultural sector and how these are shaping our food systems. ETC Group is an excellent research body documenting such trends globally. Box 1 offers a glimpse of the developments underway in the sector.

Suffice to say that these technological innovations certainly form part of the big picture in supporting the MNCs’ attempt to capture the entire value chain of the global food market, as the big players are always hunting for new technologies promising high profits – and this, in turn, dictates their acquisitive (and potentially collusive) behaviour. This is, again, a critical dimension that regulators need to be informed about. Ultimately, should some, or all, of the mergers go through, the dynamics currently at play within the six big seed and agrochemical players under review here will only be compounded – and this will dictate the new face of South Africa’s farming landscape.

Concentration in the fertiliser sector

The global fertiliser market was estimated at US\$175 billion in 2013 (ETC Group, 2015). It is far less concentrated than the seed and agrochemical markets, with Agrium Inc. (Canada) leading the global market, with an 8% global market share, followed by Yara (Norway) at 7%, The Mosaic Company (US) at 6% and PotashCorp (Canada) at 4%. Combined, these four firms captured 25% of the global market in 2013. The top 10 players together captured around 39% of the global market (ETC Group, 2015).

However, there are some indicative trends that the fertiliser market is also on its way to consolidation. In fact, this industry has been known to operate “in cartels grouped by product” (ETC Group, 2015:6) and has been investigated for its anti-competitive behaviour since the late 19th century. A probing example is that of the situation in North America, where

Box 1: New GM technologies

For a few years now, the seed and agrochemical industry has, initiated research that goes beyond transgenic technologies. These new technologies include, among others, CRISPR (Clustered Regularly Interspersed Short Palindromic Repeats) genome editing technology, synthetic biology and micronutrient fertilisation.

- CRISPR: The acronym is often used loosely to refer to the entire CRISPR-Cas9 system, a system “which can be programmed to target specific stretches of genetic code and to edit DNA at precise locations” (Broad Institute, 2017). Through such tools, genes in living cells and organisms can be modified. This technology can be used for both agriculture and human health genetic work. Unlike classical transgenesis, foreign genetic material is not necessarily introduced into the crop, a feature that is being promoted to evade GMO regulation. However, it does still involve modification of the internal genetic structure of the organisms to which it is applied. The technique is rapidly evolving and becoming a technique of choice due to its flexibility, efficiency, and cost effectiveness. In 2016 and early 2017, Monsanto entered into various licensing agreements with the Broad Institute to use CRISPR genome-editing technology, including a global non-exclusive agreement to use the CRISPR-Cpf1 system for agricultural applications (ACB, 2017a). DuPont Pioneer has entered into an agreement with the International Maize and Wheat Improvement Center (CIMMYT) to jointly develop improved crops using CRISPR-Cas advanced plant breeding technology “for characteristics that address the needs of smallholder farmers around the world” (CIMMYT 2016).
- Synthetic biology: Defined by the “US Presidential Commission for the Study of Bioethical Issues, Report on Synthetic Biology” (2011) as “... an emerging field of research that combines elements of biology, engineering, genetics, chemistry, and computer science, the diverse but related endeavours that fall under its umbrella rely on chemically synthesised DNA, along with standardised and automatable processes, to create new biochemical systems or organisms with novel or enhanced characteristics.” Synthetic biology is a very promising field for its instigators, despite the fact that there is no national or global oversight mechanism in place to regulate it (ETC Group, 2012). As synthetic biology will produce “organisms with multiple traits from multiple organisms (as opposed to GMOs, which are assessed based on a comparison of the altered organism with the natural organism on which they are based), considering each individual trait introduced” (European Group on Ethics in Science and New Technologies, cited in ETC Group, 2012), the biotech governance arrangements regulating GMOs cannot be applied to synthetic biology. The technology is much faster, cheaper and more efficient than recombinant DNA technology.¹⁹ There are serious concerns (ETC Group, 2012; Rainer Breitling et al., 2015) about the threat of such practices to biological diversity and the livelihoods of farmers and other people who rely on the natural resources for which these synthetic alternatives are being created.

three of the world’s largest fertiliser companies – namely Potash Corporation of Saskatchewan (or PotashCorp), The Mosaic Company and Agrium Inc. – control potash sales, operating as a “marketing venture” known as Canpotex (Canadian Potash Exporters). In turn, Canpotex controls over a third of global potash production capacity (ETC Group, 2015; ACB, 2015a).

Such collusion has also been rife in the South African context. The sector has indeed over the past two decades known

constant restructuring, leading to practices in contravention of the Competition Act. The CCSA investigated several cases, notably involving Sasol. In one case, Sasol came to an agreement with the CCSA regarding its part in colluding with Yara and Omnia and its abuse of dominance in the fertiliser market (ACB, 2015a). Today three players dominate the SA fertiliser sector, with Omnia Fertilizer leading, with a 45% market share, followed by Kynoch Fertilizer and Profert Holdings with an estimated 15% share each of the market.²⁰

19. Telephonic interview, Pat Mooney, Executive Director: ETC Group, 30 January 2017

20. Pers. Com., Corné Louw. Senior Economist: Inputs: Grain SA, 31 January 2017

In 2016, a potential merger between Agrium Inc. and PotashCorp (Reuters, 2016a), was under discussion. The deal, valued at US\$30 billion, was agreed to in September 2016. Aside from making the new entity the undisputed No. 1 in fertilisers, it also broadens the base of the enterprise to include seeds and crop chemicals. Weighted in terms of its market value, the sales of the merged Agrium-PotashCorp would be half of the merged Bayer-Monsanto entity (ETC Group, 2016b:5). The deal is expected to close in mid-2017 but is projected to face extensive scrutiny (Reuters, 2016b).

How will this sector evolve in the light of the current agricultural mega-mergers and the potential future fourth wave of mega-mergers? The fertiliser sector is not too involved in genomics and their expertise in the big data market remains limited (ETC, 2016a). Whether the fertiliser sector would become the target of takeovers from the agrochemical or machinery players remains unclear; the ETC Group (2016b) argues that, because of its bulk commodity character and geographic dependence (especially for phosphate and potash mines), the sector will just remain a subset of the big data players.

Farming equipment and big data

The agricultural machinery sector was worth US\$116 billion in 2013 – and was then dominated by three main players: Deere & Co. (USA) with US\$29 billion in farm equipment sales – representing 25% of the global market – CNH Industrial (Netherlands),²¹ with US\$16.7 billion and AGCO (USA)²² with US\$10.8 billion (ETC Group, 2015). These three firms combined control around half of the farming equipment market share. The next sub-section discusses the growing role this sector could play in the context of the mega-mergers.

Big data for precision agriculture:

Who is dominating the game?

Big data in the agricultural sector refers to the practice of collecting off-farm agricultural

data (such as nutrient and moisture levels in soils and weather forecasts), which is digitised, complemented with satellite imagery, and then processed through analytics – a field defined by the Oxford Dictionary²³ as “the systematic computational analysis of data or statistics” – to inform farming decisions. The technological infrastructure to capture and interpret this data includes hardware and machinery (such as tractors, combines, planters, sprayers), which is outfitted with digital tools (such as remote sensing, aerial imaging and wireless data servers) to literally “provide prescriptions” (ETC Group, 2015) to farmers as to when seeds should be planted, agrochemicals applied, fields irrigated and so forth. These tools form part of the panoply required for precision farming. Precision agriculture dates back to the 1990s; but what is new is the pace at which it has developed since the 2000s, with geographical positioning system (GPS) technology becoming cheap and widely available (Philpott, 2016). Today, the digitisation of the farming sector has reached new heights, with the development of drones and driverless tractors (see Box 2).

The drivers behind big data farming are strongly related to cost savings and securing new markets. Major biotechnology companies are spending more R&D money on products that go beyond the old GM technologies and that rely heavily on digital biotech and big data, such as seed treatments, gene editing technology with CRISPR (SeedWorld, 2016a), as well as synthetic biology (see boxes).

In this respect, the big mergers are very much about control of the big data market in agriculture (ETC Group, 2016a and 2016b). This “market” cuts across biotech and industrial agricultural production and brings them together. Bayer stated in June 2016 that one reason it wanted to buy Monsanto was to acquire a leadership role in the market for analytics (Bloomberg, 2016; Agra

21. The group was formed in 2011 following the merger of Fiat Industrial and CNH Global N.V., itself the product at the time (1999) of the acquisition by the Fiat Group of Case Corporation and its merger with New Holland N.V. to form Global N.V. (CNH Industrial 2017).

22. AGCO owns the following machinery brands: Challenger, Fendt, Massey Ferguson, Valtra, and also GIS (grain and protein solutions).

23. <https://en.oxforddictionaries.com/definition/analytics>

Box 2: Big data: Digital biotech and precision farming in Africa

A digitally equipped tractor crunching numbers and generating information on how to farm is not the most appropriate technology for African agriculture. However, this sector is clearly earmarked to grow on the big farms and plantations in the global South, including Africa. And the precision market is booming: demand for agricultural drones, robots, sensors, cameras, etc. is expected to grow from US\$2.3 billion in 2014 to US\$18.5 billion in 2024 (Markets and Markets, 2016). Micronutrient fertilisation and the high precision data it requires will no doubt add to the bonanza.

Micronutrient fertilisation is a technique consisting of increasing yields and ensuring “food security” through “judicious fertilizer management” (Bruulsema et al., 2012) of soils leading to boosted levels of zinc, iodine and selenium in the foods grown on them. Approaches include micronutrient fertilisation of soils and biofortification of foods through breeding and GM approaches. The complexities of crop nutritional status depend on multiple factors, including healthy, fertile soils; fertiliser application (which can improve or reduce nutrient status for specific micronutrients); and the focus on yields over nutritional status during the Green Revolution years. There are huge financial incentives to improve nutritional status, which appear to be a strategy to mitigate the declining nutrient content of crops as a result of the spread of industrial agricultural practices.

In terms of machinery geared to precision farming, the Case IH concept tractor is a case in point. It is an autonomous tractor that can be remotely controlled and can perform all the tasks, with precision, normally carried out by “conventional” (that is, driven) tractors (Farmers Weekly 2016).²⁴

In South Africa, the precision farming sector is described as having grown tremendously over the past decade, as a result of what industry players describe as a necessity to compensate for the lack of subsidies for the farming sector (in contrast to global competitors). Precision farming is thus seen as an imperative to contain the high price of inputs (through increased accuracy and avoidance of overlaps).²⁵

2017b). Monsanto started consolidating this position back in 2012, when the firm acquired Precision Planting and then The Climate Corporation in 2013. Both companies were then incorporated into Monsanto’s Integrated Farming Systems and Precision Planting group as “Climate Corporation” (ETC Group, 2015). Such a company, with significant ability to crunch new genomics information using seed, soil and weather data will dominate this emergent digital agriculture industry (ETC Group, 2016a). In 2015 Deere & Co made an offer to acquire Monsanto’s Precision Planting LLC. But the US Justice Department put an end to the deal to prevent Deere from dominating the precision planting market (the Brazilian regulator had also objected to this transaction).²⁶ The

arguments raised against the merger were fears that this would lead to increased prices and less innovation. Had such a deal gone through, Deere & Co and Precision Planting LLC together would have accounted for 86% of the precision planting market. Deere & Co and Monsanto said they would fight the decision (United States Department of Justice, 2016). However the two firms managed to work together through an agreement sealed in that year, whereby data pulled from Deere tractors will feed Climate Corporation’s data services (Philpott, 2016).

Other industry majors have developed similar digital products that tell the farmer what chemicals to apply, where and in what quantities. This is a

24. See footage of the (faceless) future of farming here: <https://www.caseih.com/northamerica/en-us/Pages/campaigns/autonomous-concept-vehicle.aspx>

25. Telephonic interview, Lucas Groenewald, Sales Manager: John Deere South Africa and Chairman of the South African Agricultural Machinery Association, 20 February 2017

26. Telephonic interview, Pat Mooney, Executive Director: ETC Group, 30 January 2017

Box 3: Monsanto's Climate FieldView platform

The Climate Corporation boasts of being the largest in the digital agriculture industry, having developed a “powerful” data science engine and deployed an “extensive” field research network. Its products focus on advanced seed scripting, fertility prescriptions and zone-level nitrogen monitoring capabilities (SeedWorld, 2017a). In 2015, the company launched its Climate FieldView platform, a data and knowledge management tool that relies on “deep science”²⁷ and data collected from farms to map and monitor all the parameters that can affect farming decisions (such as weather, soil nutrient levels and pests). The interface is reported to be very user-friendly: the farmer essentially uses a “Bluetooth device that can be plugged in to any engine and the data from the farming implement is then uploaded to an Ipad and stored in the cloud”.²⁸ Apple and Android mobile applications have been developed so that the farmer can easily access this data, which, allegedly, is then not shared with the firms’ parent company, Monsanto.²⁹

Monsanto claims this platform had captured, in 2016, data from over 100 million acres across the United States and Brazil. Of these, 20 million are “paid acres”, that is farms covered by the platform and for which farmers have bought packages that provide data analytics (second tier package) and even connection to “science-based” software (pro-tool) that provides “prescriptions”.³⁰

The platform was launched in Canada in 2016 and the launch in Brazil is scheduled for May 2017.³¹ The firm also eyes the European market, where it made its first breakthrough in 2015/16, with the acquisition of VitalFields, an Estonia-based European farm management software company. The company is currently assessing the feasibility of launching the platform in other countries in the next few years, including Australia, Argentina and South Africa. South Africa is an obvious market for the firm, given the established presence of Monsanto, as well as the similarities in commercial crops planted, with maize being a core crop for which the platform has been developed. Small pilot projects are currently underway in the country but the platform is not yet ready to be launched.³²

According to John Deere’s national sales manager, this firm is not involved in the pilots underway in the country,³³ which seems counter-intuitive in the light of the agreement entered into Monsanto and John Deere and the confirmation that the platform had a “global compatibility” with John Deere and Case IH.³⁴

snapshot of the armada of technologies developed by the merger contestants:

- Syngenta has developed FarmAssit, AgriEdge Excelsior, “a whole farm program ... across digital platforms”, and Water+ Intelligent Irrigation Platform (in partnership with the Lindsay Corporation (irrigation systems operating in more than 90 countries) (ETC Group, 2015);
- DuPont Pioneer’s digital armada includes Encirca Services’ “whole-farm decision service” (in partnership with Deere); Encirca Yield Stand and Encirca (in partnership with AGCO); and Yield Nitrogen Management (in partnership with DTN/The Progressive Farmer and Raven Industries) (ETC Group, 2015). As of March 2016, the nitrogen management service was used and paid for on over 400,000 hectares (Agrow, 2016b);
- BASF has the “Clearpoint Advanced” weather data platform, a partnership with Deere Iteris’ ClearAg (ETC Group, 2015). BASF also recently signed a

27. Telephonic interview, Kit Barron, Lead developer of the FieldView platform for Canada, Australia and South Africa, 23 February 2017

28. Ibidem

29. See a video explaining how the “app” works here: <https://www.youtube.com/watch?v=ErVWn6WjtjA>

30. Ibid.

31. Ibid.

32. Ibid.

33. Telephonic interview, Lucas Groenewald, Sales Manager: John Deere South Africa and Chairman of the South African Agricultural Machinery Association, 20 February 2017

34. Telephonic interview, Kit Barron, Lead developer of the FieldView platform for Canada, Australia and South Africa, 23 February 2017

- collaboration agreement with the European Space Agency (ESA) in order to make use of satellite-derived data for agricultural purposes (BASF, 2017);
- DowAgri's EXZACT Precision Technology platform is based on Deere's Integrated Solutions, for which it won't charge any fee (Agrow, 2016b); Dow also has Arcadia Biosciences platforms (ETC Group, 2015);
 - Bayer launched its Digital Farming department in 2016 and is currently developing and selling digital farming products in 10 countries (Agrow, 2016b);
 - The fertiliser industry has also hopped onto the big data wagon, with the likes of Yara, Agrium Inc., and The Mosaic Company developing various agricultural data platforms (ETC Group, 2015).

These precision planting technologies are always developed in partnership with the farm equipment industry; and this sector has proven to be very proactive in getting a foot in the door of the agri majors, as evidenced by Deere & Co, which has established strategic alliances with five of the "Big Six" companies. In 2015 it entered into an agreement with The Climate Corporation to allow some of its equipment to connect with the Climate FieldView platform wirelessly, in-cab and in "near real time" (Philpott, 2016). Around the same time, another global leader in agricultural implements, AGCO, signed a deal with Precision Planting to outfit a line of its planters with the firm's technology (ETC Group, 2015). In 2015, revenue from farm data services is said to have reached US\$2.76 billion and it was projected to grow to US\$4.8 billion by 2020 (Philpott, 2016).

But this is not only a very lucrative market; ultimately, those who control big data will control the world's food resources. As pointed out by the ETC Group (2015), as much as the advent of GM seeds in the 1990s was a game changer that saw the introduction of the "development of proprietary plant varieties dependent on proprietary pesticides", the game-changing developments of the new millennium will most certainly be big data

technology, a field in which the ETC Group (2016a:1) sees "a battle between Software genomics and Hardware informatics."

Box 4: The South African machinery sector

In 2010 the South African agriculture machinery market was valued at R1.7 billion annually and was dominated by four major farm implements: tractors, planters, balers, and combine harvesters (SAAMA, 2009). The sector turnover on new parts in 2016 was estimated at R8 billion.³⁵ South Africa has limited manufacturing capacity and produces only about 5% of the total number of tractors used in the country, with 95% of agricultural equipment being imported mainly from the US and China. South Africa is the platform for "regional expansion" into neighbouring countries. Recent sales in the sector have declined as the country has been hit hard by the drought, causing small farmers to go out of business as the cost of food production and price increases.

Tractor sales constitute around 60% of the agricultural machinery market, followed by combine and baler sales (Export, 2016). Information on market share is confidential but it seems US machinery dominates the local market, with brands such as Massey Ferguson, John Deere, New Holland and Case IH featuring strongly.³⁶ John Deere South Africa is headquartered in Johannesburg and sells implements in South Africa, Namibia and Swaziland through a network of ten dealerships.³⁷

This far-reaching consolidation throughout the agricultural value chain, superimposed on the digitisation of agriculture and other technological innovations, forms the background against which the seed and agrochemical mergers are being negotiated. In the next section we will look at the current status of global agrochemical and commercial seed markets, locating South Africa in the global context.

35. Telephonic interview, Jim Rankin, Secretary: Agfacts, 29 January 2017

36. Ibid.

37. Telephonic interview, Lucas Groenewald, Sales Manager: John Deere South Africa and Chairman of the South African Agricultural Machinery Association, 20 February 2017

Global commercial seed and agrochemical markets

Global commercial seed markets

The global seed market has an estimated value of about US\$41 billion (ETC Group, 2015). Monsanto is the largest corporation in the commercial seed sector, with a market share of 26% (US\$10.7 billion), followed by DuPont Pioneer at 21 % (US\$8.6 billion) and Syngenta at 8% (US\$3.3 billion). Dow at 4% (US\$1.6 billion) and Bayer at 3% (US\$1.2 billion) are also in the top seven, alongside Limagrain at 5% and KWS at 4%.³⁸ Today the global seed market is deeply interlinked with the agrochemical market – as the ETC Group (2015) reports, almost all GM seeds have been designed to be herbicide resistant. The GM seed market was worth US\$15.6 billion in 2011 and was expected to grow to US\$30.2 billion in 2018 (Agro Professional, 2013). However, despite the projected growth of transgenic crops, especially in the global South, a recent market report notes that conventional seeds are expected to be the fastest growing segment of total seed sales (Markets & Markets, 2016), with a slow drop in investment in GM seed.

The African seed market contributes less than 2% to the current value of the market (CTA, 2015). This is likely driven by cost and the time it takes to get regulatory approval. The cost to bring a genetically modified seed to market is estimated at US\$136 million and it can take more than a decade, with up to seven years being dedicated to getting regulatory approval for different markets (SeedWorld, 2016a). This contrasts with the estimated US\$1 million it costs to bring conventional hybrids to market (ETC Group, 2015b).

The markets are interlinked. For example, the increased uptake of hybrid and GM seed is accompanied by increased uptake of herbicides because they are sold as parts of packages. A recent market report notes that herbicides are the most popular form

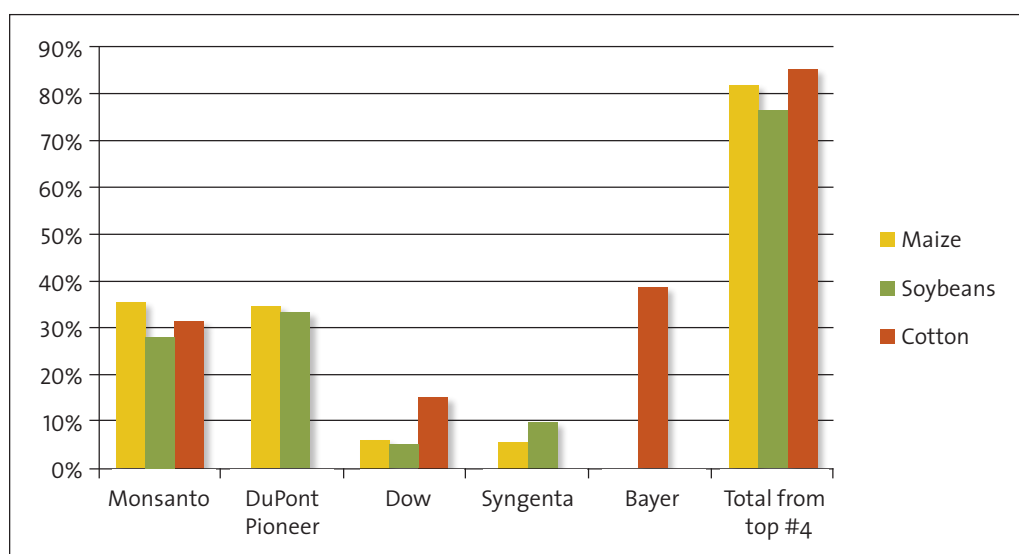
of crop protection chemical for both GM and non-GM crops, including for use on major field crops (cereals, maize, soybean, rice, rape seed, sugar beet, cotton, sugarcane and sunflower) (Report Buyer, 2016).

Industry bodies have also picked up on a new trend that is gaining momentum: the big agrochemical companies are broadening their product range to include biopesticides and seed care (Agrow, 2016b). Biopesticides are made from naturally occurring substances that control pests by non-toxic mechanisms and in an ecofriendly manner. They may be derived from animals (such as nematodes), plants (such as *Chrysanthemum* and *Azadirachta*) and microorganisms (such as *Bacillus thuringiensis*, *Trichoderma* and *Nuclear polyhedrosis virus* – or NPV), and include living organisms (natural enemies), their products (phytochemicals, microbial products) or byproducts (semiochemicals) (Mazid et al., 2011). These characteristics render biopesticides less toxic than chemical pesticides (although still not entirely innocuous), and they are portrayed as being more environmentally friendly than their chemical alternatives (BPIA, 2017). A 2008 study estimated that biopesticides represented about 3% of the overall pesticides market (Global Industry Analysts, 2008 as cited in Biopesticide Industry Alliance 2017). The Big Six are very present on this front. DuPont, for instance, acquired Taxon Biosciences in 2015.

Bayer and Syngenta are the leading firms in the “seed care” sector, a term coined by the industry to refer to seed treatment, with Syngenta having developed seed care institutes around the world. DuPont launched several new seed care products in 2014 and 2015 (Agrow, 2016b). Monsanto’s seed care products are sold under the Acceleron brand, which focuses on the treatment of maize, soya and cotton seeds. These firms are also focusing their research on ostensibly improving plant nutrition, which entails optimising fertiliser use (through big data), developing bio-stimulants and products that improve nitrogen uptake and also developing seed traits that enhance the use of nitrogen in the plant. Such products

38. Figures based on market shares in ETC Group (2015) and market size from ETC Group (2016b).

Figure 1: Seed market shares in the USA (maize and soybean shares 2014 and upland cotton shares 2015)



Source: Based on Bryant et al., 2016:25

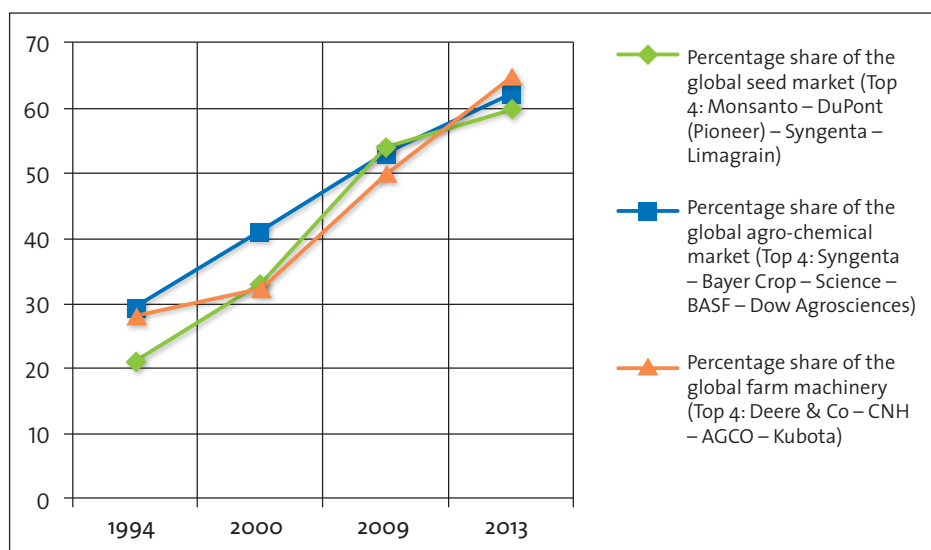
include, for instance, Monsanto's BioAg products to increase nitrogen uptake from the air and DuPont's Encirca, which offer a nitrogen manager option (Agrow, 2016b).

But other major technological developments are underway that will soon surpass the boundaries that genetic engineering pushed back over two decades ago in the field of genomics. The CRISPR genome-editing technology is a field in which Monsanto, for instance, has entered into various licensing agreements with the Broad Institute. Under these agreements, Monsanto is allowed to use CRISPR genome-editing technology in 2016 and early 2017, including a global non-exclusive agreement to use the CRISPR-Cpf1 system for agricultural applications (SeedWorld, 2017b). Monsanto is also partnering with HydroBio Inc. to explore the use of satellite imagery, remote sensing analytics and irrigation management to develop a global irrigation management tool. South Africa is one of ten countries where this technology is being trialled (SeedWorld, 2016b).

The number of independent, large-scale seed companies operating in the global seed industry shrank from about 600 to just 100 in 2009, with Monsanto, DuPont Pioneer and Syngenta dominating (Stucke and Grunes, 2016). In 2013, Monsanto (29% of the field crop market share), DuPont Pioneer (21%) and

Syngenta (10%) jointly controlled 60% of the market share in field crops (ETC Group, 2015). A report by the United States Department of Agriculture notes that the crop seed industry has experienced the most extensive consolidation over time of any agricultural input (Stucke and Grunes 2016). In the United States, the share of seed sales of the top four commercial crops controlled by the top four MNCs reached astronomical proportions in the 2014–15 growing seasons: close to 82% for maize, 76% for soybeans and 85% for cotton (see Figure 1). Maize and horticulture are the two biggest seed markets on the African continent, with the maize market valued at about US\$500 million and horticulture at US\$250 million; most seed company activity takes place in this space (ACB, 2015c & 2017a).

As Figure 2 shows, the growth in global market concentration across machinery, agrochemicals and seed was rapid. Of these, seed was the most intense, with the top four firms' market share nearly tripling between 1994 and 2013 from 21% to 60%. As underlined by the ETC Group (2015), these figures are far above the "four-firm concentration ratio" of 40% of a given market being controlled by four firms as a threshold given by economists as a tell-tale sign of over-concentration. This is because, with such market control, dominant firms can easily dictate price increases, as their intention to do so will be followed by others

Figure 2: Percentage share of the global seed, agrochemical and farm machinery markets

Source: Based on Fuglie et al. (2012) and ETC Group (2015)

who find it works in their interests (Scherer and Ross, 1990 as cited in Howard, 2016).

Global agrochemical markets

The global agrochemical market has an estimated value of around US\$56 billion (ETC Group, 2015; 2016b).³⁹ Agrochemicals is a term used here to refer specifically to crop protection, which includes herbicides, insecticides, fungicides and the pre-treatment of seeds. The largest agrochemical corporations are Syngenta at 20% (US\$11.2 billion), Bayer at 18% (US\$10.1 billion), BASF at 13% (US\$7.3 billion), Dow at 10% (US\$5.5 billion), Monsanto at 8% (US\$4.5 billion) and DuPont at 6% (3.4 billion);⁴⁰ these six firms controlled 75% of the global agrochemical market in 2015. Chinese-owned ChemChina doesn't make divisional sales figures available, but total sales were US\$45 billion in 2015 (Alessi, 2016).

The other mega player, BASF – number three in crop chemicals (and a relatively minor actor in the seed sector) – has seemingly remained on the side-lines of the current round of merger talks. However, in early 2016 the firm was reported to have attempted

to halt the Dow-DuPont merger and to make a counter-bid for DuPont (Fortune, 2016). The expectation is that BASF will be expressing interest in acquiring the divestments made by one or more of the merging entities. BASF attended a recent confidential briefing session in the US on the remedies proposed for the Dow-DuPont merger and reportedly expressed interest in snapping up some of the companies' divested assets (Wall Street Journal, 2017). An alternative (or complementary) scenario is that this company opts to expand its footprint by acquiring smaller players in the agrochemical/seed sector (German, Dutch, US and Japanese) (ETC Group, 2016a), or that it ends up being acquired by a larger player (for example, the machinery companies).

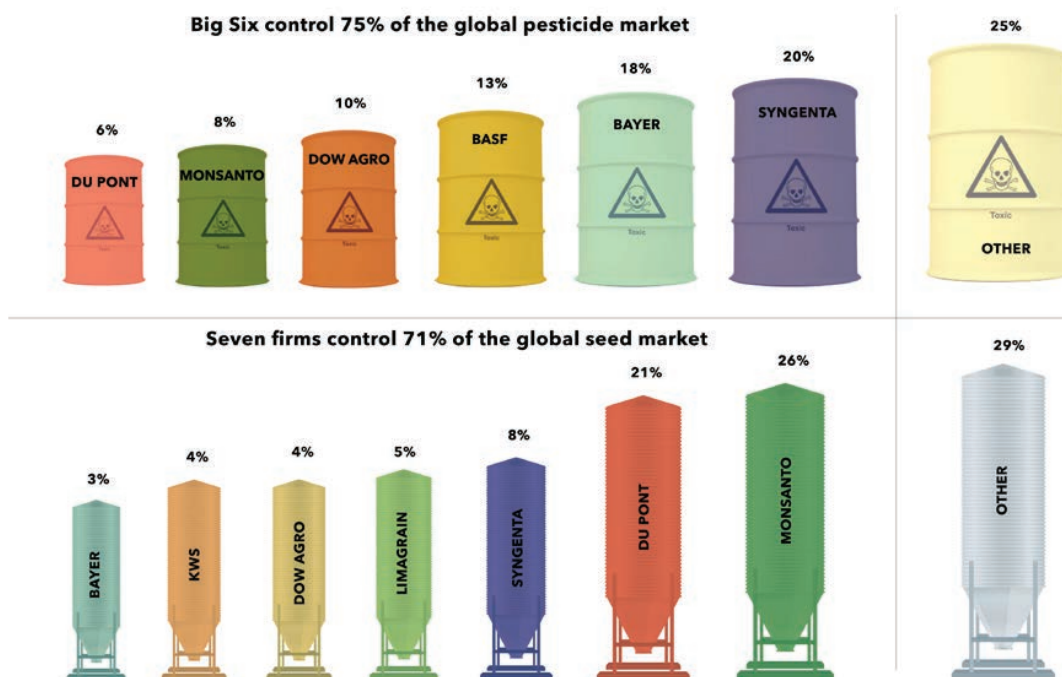
Today, we are on the cusp of a third global wave of mega-mergers, as the Big Six seed and agrochemical companies are engaged in merger talks. More precisely, all of the top six agrochemical players, except for BASF, and four of the top five seed players (aside from French-owned Limagrain, which is number four globally) are considering consolidating. The merger discussions capturing the world's attention today involve the following firms:

39. A very recent estimate values this market at US\$214.2 billion in 2015 (Markets & Markets, 2016), a figure that is difficult to verify but which would imply the market has more than tripled in three years, a growth that is most certainly improbable.

40. Figures based on market shares in ETC Group, 2015 and market size from ETC Group (2016b).

SEED AND AGROCHEMICAL MARKETS

CORPORATE CONCENTRATION IN GLOBAL COMMERCIAL PESTICIDE AND SEED MARKETS



- ChemChina (which owns the world's seventh largest agrochemical company, ADAMA) made a bid in November 2015 to acquire Syngenta (first in the global agrochemical market and third in the global seed market);
- A "merger of equals" was announced in December 2015 between DuPont (second in the global seed market; sixth in pesticides) and Dow Chemical (with DowAgri, the agricultural business of the Dow Group, fifth in the global seed market, fourth in the global agrochemical market);
- Bayer CropScience (second in the agrochemical market and seventh in the seed market) made a bid in September 2016 to acquire Monsanto (first in the global seed market and fifth in the global agrochemical market).

Figure 3 shows what the global seed and agrochemical picture would look like should these three mergers go through. The combined market has an estimated value of US\$97 billion (pro forma, based on 2014 figures) (ETC Group, 2016b).

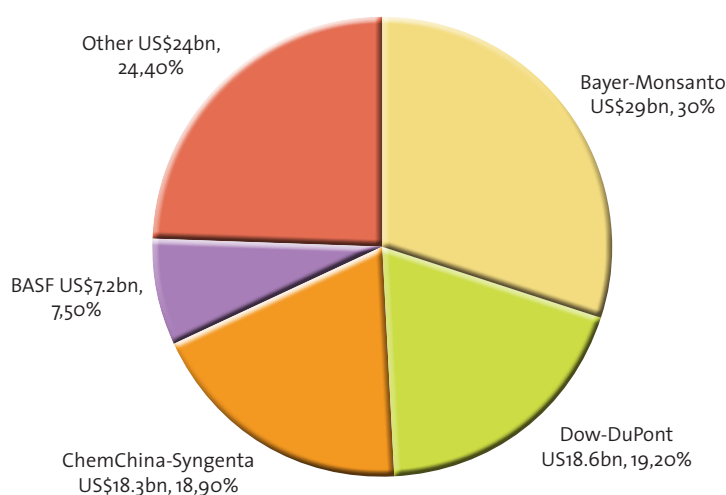
South African commercial seed and agrochemical markets

South African commercial seed markets

Latest data for the 2015/16 season from the South African National Seed Organisation (Sansor) shows that the market for agronomic crops was valued at R4.56 billion, of which maize counted R3.59 billion. The horticulture market was valued at R0.89 billion and the forage market at R0.53 billion (Figure 4). The total market value of the country's crops thus amounted to R5.98 billion, of which maize accounted for around 60%. The strong dominance of maize in South Africa's agricultural landscape illustrates how the country is already driven down a technological pathway that reduces diversity and focuses on a small number of lucrative crops, as previously discussed by the ACB (2016a).

The South African commercial seed sector has already known considerable consolidation, which started in the 1990s with the liberalisation of the seed sector. In the late 1990s Monsanto acquired Sensako and Carnia, two of South Africa's

Figure 3: Future of the combined seed and agrochemical markets if all three mergers go through

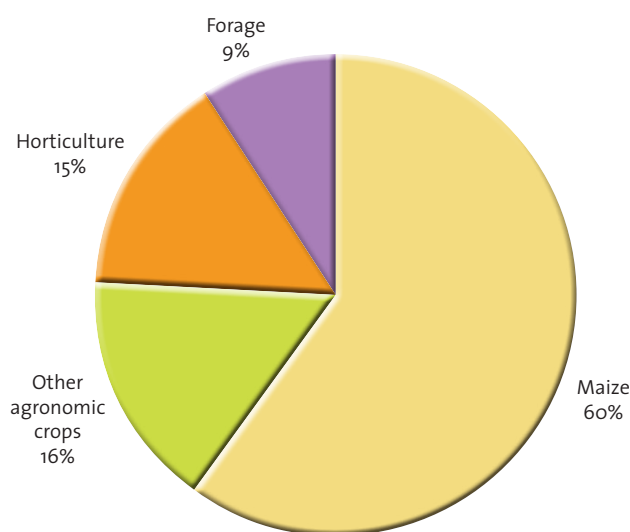


Source: ETC Group (2016b:6)

biggest grain seed companies at the time. It further expanded its footprint in the South African seed sector with the acquisitions of Delta & Pinelands (D&PL), Seminis, De Ruiters and Mahyco in the early 2000s (ACB 2009). In May 2012, the Competition Appeals Court⁴¹ approved the acquisition of Pannar, South Africa's largest seed company at the time, by Pioneer Hi-Bred, a fully owned subsidiary of DuPont (now called Du Pont Pioneer with Pannar as a leading brand in South and Southern Africa).

It is not possible to establish detailed market shares because this information is considered commercially sensitive and is not shared publicly. Based on DAFF's list of registered varieties, the number of varieties held by the various seed players in the country can be inventoried (Table 2). This information will not give the market share of these firms but can indicate the number of registered varieties they own. This does provide some indication of their size as well as their areas of focus.

Figure 4: Top South African commercial seed crop markets by value, 2015/16



Source: Based on SANSOR market data, 2015/16

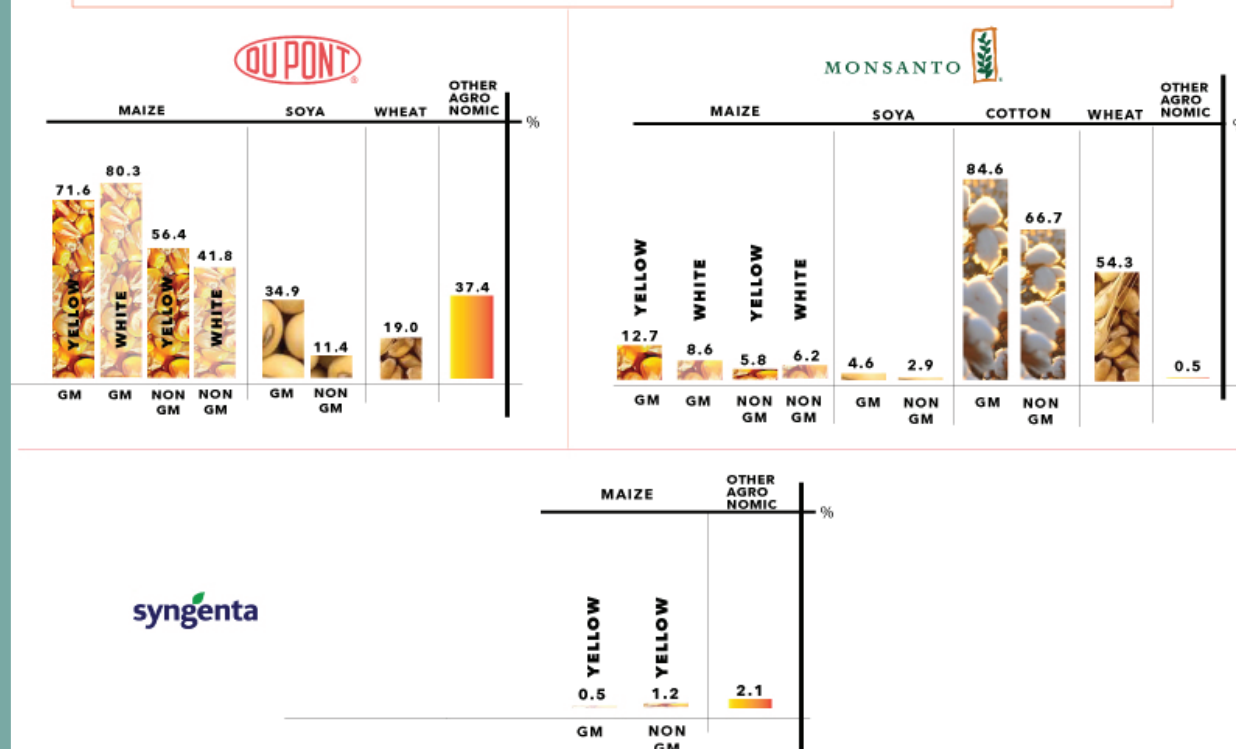
41. The merger was twice rejected: once by the Competition Commission and then by the Competition Tribunal (ACB, 2012).

Table 2: Number of registered varieties owned by the merging parties in South Africa, November 2016

	Maize						Soya		Cotton		Wheat	Other agronomic	Horticulture	Forage	Total
	GM yellow	Non-GM hybrid yellow	OPV yellow	GM white	Non-GM hybrid white	OPV white	GM	Non-GM	GM	Non-GM					
Du Pont Pioneer	141	97	1	122	81	2	38	4	-	-	22	140	-	28	676
Du Pont %	71.6	56.4	14.3	80.3	41.8	6.9	34.9	11.4	0.0	0.0	19.0	37.4	0.0	7.1	22.9
- Pioneer Hi-Bred SA	117	71		95	45		18					23			369
- Pannar Seed	24	26	1	27	36	2	20	4			22	117		28	307
Monsanto	25	10	-	13	12	1	5	1	11	8	63	2	83	12	246
Monsanto %	12.7	5.8	0.0	8.6	6.2	3.4	4.6	2.9	84.6	66.7	54.3	0.5	7.2	3.0	8.3
- Monsanto SA	25	7		13	11			1	8				80	1	146
- Sensako					1	1	5				63	2		11	83
- D&PL SA									3	1					4
- Mayhco		3								7			3		13
Syngenta	1	2										8	99		110
Syngenta %	0.5	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	8.6	0.0	3.7
Bayer Crop Science									2	1		2			5
Dow												4			4
Other	30	63	6	17	101	26	66	30	-	3	31	218	963	355	1,909
Total	197	172	7	152	194	29	109	35	13	12	116	374	1,145	395	2,950

Source: Compiled from DAFF National Varietal List, November 2016

PERCENTAGE OF REGISTERED SEED VARIETIES OWNED BY MERGING PARTIES IN SOUTH AFRICA



Du Pont Pioneer and Monsanto dominate the maize and soya seed markets. GM seed is permitted for commercial use for three crops in South Africa at present: maize, soya and cotton. South Africa is the first and only country in the world to permit commercial GM production of its staple crop, maize. South Africa is the ninth largest producer of biotech crops in the world. The interest in GM crops for key commodities in the country is on the rise; in 2008, there were 94 GM varieties available in South Africa (ACB 2009); this number has more than tripled, with a total of 349 GM varieties listed in 2016.

GM cultivation of maize (both white and yellow) has risen from around 69% of all plantings in 2011/12 to 89% in 2015/16 (Esterhuizen, 2016). By 2013 GM varieties already constituted 90% of total soya cultivated (Gouse, 2014:15). The National Varietal List indicates that Du Pont Pioneer holds by far the most maize varieties, especially of GM seed varieties. This has created a highly concentrated market, with Du Pont Pioneer now owning 80% of GM

white maize varieties, 72% of GM yellow maize varieties, 56% of non-GM yellow maize hybrids and 42% of non-GM white hybrids (see Table 2). In soya, Du Pont Pioneer holds 35% of GM varieties. Comparatively speaking, Monsanto owns a relatively smaller share of registered varieties, at 9% of GM white maize, 13% of GM yellow maize and just less than 5% of GM soya. However, almost all GM maize and soya varieties in South Africa license patented traits from Monsanto, including those held by Du Pont Pioneer.

Monsanto and Du Pont Pioneer are also dominant in the wheat seed sector, with 73% of registered varieties between them. Monsanto on its own has over half of all registered wheat varieties. In cotton Monsanto is also dominant, although this market is small in South Africa, and has been decimated in recent years. Du Pont Pioneer has well over a third of registered varieties for all other agronomic crops. These two corporations between them hold 31.2% of all varieties registered on the national list. Monsanto also operates in

the horticulture sector, as does Syngenta. Bayer, Dow and ChemChina have little or no involvement in South Africa's seed sector and operate rather in agrochemicals.

The private sector dominates plant breeding in South Africa, with a particular focus on the breeding of maize varieties. Of the 27 active maize variety breeders in South Africa, 26 are in the private sector (TASAI, 2015). The public research institution, the Agricultural Research Council (ARC), conducts research at its Grain Crops Institute. There are only seven breeders focused on soybean, ten on sunflower and nine on wheat varieties (TASAI, 2015). There are only two public breeders for maize and for wheat and none for soybean and sunflower (TASAI, 2015).

African and South African agrochemicals markets

In 2015 the African agrochemical market was valued at around US\$2.1 billion (around R26.8 billion at the time) (Agrow, 2016a) – around 3.5% of the global market value, of which South Africa held 2% (Agrihandbook, 2016). Insecticides and herbicides combined account for 82% of all remedies used (Agrow, 2016a). The continental market is growing fast; since the 1990s it is reported to have grown by a factor of 3.6, from about US\$590 million in 1995 to the current US\$2.1 billion. There is an expectation that the market will grow even faster over the next decade. An estimated annual compounded rate of 8.5% over the next 15 years means that the agro-chemical market could potentially reach an estimated value of US\$7.5 billion by 2030 (Agrow 2016a) and this certainly will attract agrochemical MNCs the world over.

Africa is a rising star in the agrochemical market and a vast, but generally little-known region awaiting in-depth agricultural and agrochemical development. The recent strategic development of multinationals, such as Syngenta, Bayer CropScience, Dow AgroSciences, DuPont, Monsanto, ADAMA, UPL, Arysta and others is clear. With several more traditional markets attaining maturity, there are signs that the global market is approaching saturation. Africa – the large and populous continent, which is relatively poor but shows increasing demand for food and technology – has an enormous potential for agrochemical enterprises (Agrow, 2016a:11)

The Big Six also dominate the African agrochemical market, with Syngenta, Bayer, BASF, Dow, Monsanto and DuPont in the lead, and others, such as Arysta, UPL, Sumitomo and Wynca Chemical also featuring. Enterprises from countries, such as China and India, who have come to lead in the export of generic pesticides, also enjoy a “strong position” on the continent, as testified by the strong presence of ADAMA formally Makhteshim Agan, an Israeli firm, which was acquired by ChemChina in 2011) on the continent. The biggest agrochemical markets in Africa are South Africa, Egypt, Nigeria, Morocco, Kenya, Ghana, Algeria and Ivory Coast (Agrow 2016a).

South Africa uses more crop protection agrochemicals than any other African country, mostly for grain and cereal crop production (PR Newswire, 2015), and stands out as the one country in the world where the use of pesticides is growing the fastest. According to the United Nations Programme for Environment's 2012 Global Chemical Outlook, total pesticide expenditures in South Africa rose 59% over the period 1999 to 2009, and are projected to rise another 55% in the period 2009 to 2019. South African farmers spent R2.3 billion on agrochemicals in the 2014/15 season (Grain SA 2015). Increasing

REGISTERED CHEMICAL ACTIVE INGREDIENTS



SOURCE: COMPILED FROM AVCASA DATABASE OF REGISTERED ACTIVE INGREDIENTS

expenditure is in part attributable to increasing input prices and pest resistance.⁴²

Major agrochemical companies operating in the country are Universal Crop Protection, Villa Crop Protection, Volcano Agrosience, Arysta Life Science SA, Meridian Agrochemical Co., Bayer, Syngenta, ADAMA (owned by ChemChina), Dow AgroSciences, Philagro South Africa, BASF South Africa, Sipcam, Monsanto and Chemtura Corporation (Grain SA, 2015). The bulk of agrochemicals used in South Africa are imported (ACB, 2009), hence the large agrochemical multinationals dominate the South African market. There is intense competition in this sector and an industry player described it as being “over-traded”.⁴³

Croplife South Africa, an association representing the plant science industry, has a total of 50 companies registered as suppliers of crop protection products and

29 companies are registered as distributors. However an industry insider indicates that the network of distributors counts over 40 firms with 930 agents between them.⁴⁴

The merger applicants’ subsidiaries in South Africa essentially have the role of warehousing and managing the distribution of imported agrochemicals.⁴⁵ International firms typically deploy research teams locally, in charge of conducting the toxicology and regulatory compliance tests required to register the chemical active ingredients (“actives”) in the country. Only Syngenta and Bayer have their own chemical formulation plants in the country. With regards to Syngenta, ChemChina’s intention after the merger is to shut down this plant and import all formulated products (see Box 5).

Market information is proprietary, making it is extremely difficult to determine industry market shares. The databases compiled

42. It was recently reported that worldwide a total of 210 species of weeds show herbicide-resistance (IPES Food, 2016:16)

43. Telephonic interview, Ocki Olivier, CEO: ADAMA South Africa, 30 January 2017.

44. Ibid.

45. The production of agrochemicals takes place in three stages: the manufacture of active ingredients, the formulation of chemical mixes (formulated products) from active substances, and the packaging and distribution of these products.

Table 3: Number of registered chemical active ingredients by the merging entities and BASF

	Herbicides	Insecticides	Fungicides	Plant growth regulators	Total
Monsanto	9	0	0	3	12
Bayer	13	16	32	7	68
Bayer-Monsanto combined unique	20	16	32	10	78
Dow	35	15	10	3	63
Du Pont	12	3	9	0	24
Dow-Du Pont combined unique	46	18	19	3	86
Adama/Makhteshim-Agan (ChemChina)	45	23	20	2	90
Syngenta	30	13	22	6	71
ChemChina-Syngenta combined unique	70	33	36	8	147
BASF	14	8	26	4	52

Source: Compiled from AVCASA database of registered active ingredients, 2016

by the Association of Veterinary and Crop Protection Associations of South Africa (AVCASA), which list all the active chemical ingredients and products registered by company, offers a proxy measure of the footprint of players in agrochemicals. ChemChina (through ADAMA /Makhteshim-Agan) and Syngenta, followed by Dow, Bayer and BASF have a significant number of registered active ingredients. Du Pont and Monsanto have comparatively fewer. As indicated earlier, these two corporations are dominant in major seed sectors, and their respective mergers will therefore result in strong integration between seed and agrochemicals. In contrast, the ChemChina-Syngenta merger will mainly enhance their strong position in agrochemicals, although Syngenta also holds a significant share of horticulture seed varieties, as indicated earlier. ChemChina is a clear leader among the suppliers of generic agro-chemicals on the South African market. These multinationals distinguish themselves from domestic companies, such as Villa Crop Protection and Volcano Agrosience in that they hold patents on active ingredients, while the domestic companies produce under license.

Under scrutiny: the merging of the Big Six

This section provides detailed background information about the ChemChina-Syngenta and Dow Chemical-DuPont mergers. Information relating to the Bayer-Monsanto transaction is the subject of recent research by ACB (ACB, 2017a&b). Activities of these companies in South African agrochemical and seed markets are also discussed.

The ChemChina offer to acquire Syngenta

Syngenta

Syngenta is one of the world's largest agribusiness and operates in crop protection, seeds, lawn and garden markets in over 90 countries. The firm originates from the 2000 merger of the Zeneca and Novartis agricultural businesses. The Switzerland-based firm has since been listed on the Swiss Exchange (SIX: SYNN) (N+1 Swiss Capital, 2016).

Syngenta's African headquarters are in South Africa (Midrand) and the firm also has offices in Nairobi, Kenya, where it opened

its second African seed treatment institute in 2016. Syngenta plans to expand into the continent's western nations in the next five years. In South Africa, Syngenta has a formulation plant in Brits in the North West, where it manufactures agrochemicals. The Brits unit is Syngenta's 11th plant and the group has proposed opening 18 such centres globally, although the CCSA merger file indicated plans to shut down the Brits plant (Syngenta 2016a). The CCSA requested that this plant remains operational until such time as the local workforce is retrained to be able to find alternative employment. The period for which the plant would have to keep operating is being kept confidential. In terms of R&D, Syngenta South Africa does biological development of new products, label expansions, crop programmes and crop solutions and also supports global development and research (Syngenta, 2016a).

Syngenta's focus crops in South Africa are cereals (with a specific focus on wheat and white maize), legumes and oilseeds (with a focus on soybean and sunflower), sugarcane, fruit and vegetable (with a specific focus on potatoes) (Syngenta, 2016b). Syngenta portrays itself as one of the main players in the development of new traits to further enhance white maize yields. In the oil segment, Syngenta positioned itself as "world leader in sunflower", thanks to their acquisition of Monsanto's global sunflower business that was concluded at the end of 2010 (Syngenta, 2016d). Their product offer includes packages that offer "all-in-one solutions" from seed treatment to post planting that integrate seeds, crop protection and agronomic services (a wide range of seed treatment, insecticides, herbicides and fungicides). Syngenta South Africa prides itself to have become in 2005 the first company to have introduced such an "integrated" crop production programme for potatoes, PotatoPack (Syngenta 2016e).

ChemChina

Officially known as China National Chemical Corporation, ChemChina is a fast-growing Chinese state business headquartered in Beijing. It owns production, R&D and marketing systems in 150 countries and regions. It is the largest chemical corporation in China, and occupies the 234th position among the Fortune 500 (ChemChina,

2016a). The firm's core business is chemicals, and agrochemicals is one of six divisions (ChemChina, 2016b), with a focus on manufacture of non-patented herbicides, insecticides, bactericides, plant growth regulators. The corporation manufactures 120 kinds of pesticides and over 800 preparations and has registered close to 5,000 products and over 6,000 trademarks in 120 countries (ChemChina, 2016c). It employs more than 140,000 people, including 48,000 employees outside China. ChemChina does not make disaggregated figures by division available; the group had a global turnover of US\$45 billion in 2015, which is three times greater than Syngenta's turnover for the same period (MultiWatch, 2016), although this figure covers all the groups' activities as opposed to Syngenta's core focus on agriculture.

ChemChina intends capturing the fast-growing Chinese market through consolidation, as well as expanding its market share primarily in Europe and Latin America (ETC Group, 2015), as testified by the company's several overseas acquisitions (essentially in Europe) over the past few years (ChemChina, 2016d). The acquisition of Syngenta would be the third major investment in the agrochemical industry after ChemChina acquired French group Adisseo in 2006 (ChemChina, 2016a), the global leader in the production of additives and nutrition for animal feed (Adisseo, 2016) and took over the majority stake in the Israeli company Makhteshim-Agan Industries (MAI) in 2011 (then the seventh largest agrochemical manufacturer) and more recently gained full control after the remaining shareholders sold their stake to ChemChina. MAI is the world's largest manufacturer of generic crop protection products and now operates under the name ADAMA Agricultural Solutions Ltd (Seeking Alpha, 2016). In early 2017 there were talks with Chinese agrochemical company Sanonda about combining with ADAMA (Agra, 2017a). The firm has also been expanding its other chemical products and according to some analysts is poised to "join the top fifty global chemical companies, sooner rather than later" (MultiWatch, 2016:22).

ChemChina operates in South Africa through ADAMA South Africa, which is involved in

the testing and registration of agrochemical products. ADAMA's largest market is Europe (37%), followed by Latin America (25%). ADAMA is a leader in generic products but also has its own product range.⁴⁶ The company is in the process of building a new 60,000 ton capacity pesticide plant in China (Agrow, 2016b). ADAMA SA essentially imports all its products from overseas and does not have a manufacturing plant in the country. It is highly likely that ADAMA SA will import its formulated products from there should the Syngenta plant shut down.

Where does the transaction stand now?

In February 2016, the Syngenta Board unanimously accepted ChemChina's latest bid, to acquire Syngenta for the sum of over US\$43 billion, which was higher than a previous bid that was turned down (MultiWatch, 2016:21). The ChemChina-Syngenta deal is not a merger process; it is a straight acquisition by ChemChina. It is estimated that the acquisition of Syngenta would give ChemChina a 26% market share in the global agrochemical market (based on 2013 revenues), making ChemChina the leader in the Chinese market (ETC Group, 2015).

The deal has been approved by regulators in several markets, including the Committee on Foreign Investment in the United States in August 2016 (Syngenta, 2016e) and the Australian Competition and Consumer Commission (ACCC). The latter has unconditionally cleared the acquisition, despite finding overlaps between the two companies' products (ACCC, 2016).⁴⁷ However the European Commission did not approve the acquisition after the first phase of the review process and began investigating ChemChina's takeover of Syngenta in October 2016, as concerns over potentially unfair competitive advantages had not been allayed.

In January 2017 the two firms were reported to have proposed minor concessions to the EU's competition watchdog to address concerns over their merger plan. These

include the already consolidated nature of the market, the fact that the parties hold a relatively high combined market share in some segments and that the merger could decrease both companies' supplies of active ingredients, which are used by other manufacturers (European Competition Commission, 2016). ADAMA stands out as one area where ChemChina and Syngenta have an overlapping portfolio of European herbicides and insecticides. Some sources mention possible divestments from ADAMA, estimated at less than US\$500 million (Reuters, 2017a and b), whilst others indicate that ChemChina had agreed to divest products in more than a dozen EU countries – some from ADAMA, and some from Syngenta (Seeking Alpha, 2017). All these possible divestitures will certainly raise BASF's interest as a potential buyer. The US Federal Trade Commission has also requested more time to review the ChemChina-Syngenta deal, but the firms stated they were confident a ruling could be made by the time the EU regulator shares the outcome of its in-depth investigation (AGWeb, 2017) in April 2017.

Media reports of a merger of Chinese state-owned chemical firms Sinochem Group and ChemChina were formally recently dismissed as being "just rumours", as reported by Reuters (2016c), in an interview with Sinochem Group Chairman Ning Gaoning. Such a deal would have complicated the acquiring process with Syngenta.

In contrast to the market gains Syngenta would have made in the seed sector through a deal with Monsanto, MultiWatch underlines that ChemChina opens up whole new avenues for the Basel Law Firm, especially in terms of market expansion into China, "but most likely also in Africa, where higher volumes of investment are to be expected" (MultiWatch, 2016:22). The ChemChina deal might be the merger that has the greatest impact on Africa, because ultimately the direction of Chinese capital's strategic interests will play a part in shaping the agricultural technologies pushed onto

46. Telephonic interview, Ocki Olivier, CEO: ADAMA South Africa, 30 January 2017

47. Australia's competition watchdog said it examined the deal because ChemChina owns a subsidiary that competes with Syngenta in Australia. It found the proposed deal would not damage competition in the sector, as the combined entity would still compete with businesses such as Bayer, BASF, Monsanto, Nufarm, Dow, DuPont, and FMC. Note the lack of reference to the other pending mergers.

Box 5: The ChemChina-Syngenta transaction in South Africa

South Africa's Competition Commission approved ChemChina's acquisition of Syngenta in September 2016 with conditions (Competition Commission, 2016). The Commission has categorised the transaction as an "intermediate transaction" as the combined turnover of the two concerned firms in South Africa is lower than R560 million and the asset value of Syngenta is below R80 million.⁴⁸ The Commission found that there was no overlap in the manufacturing of the chemical remedies, as the parties do not manufacture any products in South Africa. The firms compete in the distribution of these products but as competition in the sector is fierce – with over forty distributors of agrochemicals and seed treatment products – it was concluded that the merged entity would be "constrained".

At the formulation level, the two merging candidates are not competing in the same market, as ADAMA essentially only sells generic agrochemicals (which are formulated from inputs sourced from any of the producers of the active ingredients, such as the likes of Dow, DuPont or Bayer), as opposed to Syngenta, which sells products that are still under patent. This was a consideration for the Commission as it entails that they are competing in different price segments, with the original (patented) products being sold at a much higher price than generic products.⁴⁹ The Commission however looked at the broad market encompassing both products.

The investigation "identified horizontal overlaps in the business activities of the merging parties in the market for the manufacture and supply of agrochemicals or crop protection products, namely fungicides, insecticides, herbicides (selective and nonselective) and seed treatment products" (Competition Commission, 2017:3). The combined market shares in the majority of the overlapping areas were found to be less than 15% of the national market share. This, according to the Commission, indicated that, should the two firms merge, it wouldn't compromise competition in the markets, especially in the light of the fact of continuing competition from "reputable firms" such as Bayer, BASF, Monsanto, Villa Crop Protection, Agchem Africa, Dow, DuPont and Arysta LifeScience, amongst others in a number of markets (Competition Commission, 2017:4)

The public interest concern that was picked up by the investigating team was the possibility of the merged entity shutting down Syngenta's formulation plant in the country and importing all of its products. This would result in job losses and import substitution and have a negative effect on this economically depressed area of the country. The condition imposed on the merged parties is that the formulation plant should not be relocated for a certain period of time, the duration of which is being kept confidential.

Africa. For now the Chinese government has not adopted GMOs but a shift in policy would have major implications in the seed world. Between 2009 and 2012, China's Foreign Direct Investment (FDI) in Africa grew at an annual rate of 20.5% (China Africa Research Initiative, 2013), with the Chinese government reporting that its cumulative FDI into Africa from 2000 to 2014 was US\$30 billion (Foreign Ministry of the People's Republic of China, 2015).

The Dow Chemical-DuPont merger

Dow Chemical

Dow Chemical is a US firm with headquarters in Midland, Michigan. In 2015, Dow had annual sales of nearly US\$49 billion and employed approximately 49,500 people worldwide (Dow, 2016b). The group has a presence in about 180 countries and has a strong presence in Africa and the Middle East. Offices in Sub-Saharan countries include Ghana (established in 2011 as the hub for

48. Telephonic interview, Zanele Hadebe and Lindiwe Khumalo, respectively South African Competition Commission's lead analyst for the ChemChina-Syngenta transaction and her supervisor, 20 January 2017

49. Ibid.

the fast growing West Africa region), Kenya (established in 2010 for commercial activities in East Africa), Nigeria, and South Africa. Since 1959, Dow Africa has been headquartered in Johannesburg, where it started. This office operates as the hub for Dow's commercial activities in Southern Africa.

The company's more than 6,000 product families are manufactured at 179 sites in 35 countries across the globe (Dow, 2016b). Between 2006 and 2014, Dow has significantly expanded its R&D capacity. The firm's most important product sector is herbicides, which account for 60% of sales, followed by insecticides and fungicides (Agrow, 2016b). These global figures are also true for the South African market.⁵⁰ Dow has heavily invested in its seed sector over the years, focusing both on input and output traits. Its biggest selling crop is corn, followed by soybeans, oilseeds and cotton (Agrow, 2016b). Dow's seed sector is reported to have grown by an average annual rate of 19% since 2006. The firm reports having doubled the square footage in laboratories for seeds, having grown the surface area of its greenhouses by over 77% and added over 90% acreage at R&D field stations (DowAgri, 2016).

It is through a history of acquisitions that Dow set foot in South Africa's agrochemical sector. In 1997 Dow Chemicals acquired Sentrachem, itself the product of a merger between three industrial and chemical companies. Its subsidiary Sanachem had two subsidiaries: Agricura and Efekto (which was subsequently sold to Pannar). Agricura, Dow's ultimate target, was renamed as Agrihold after the acquisition, and then the group restructured Agrihold and Sanachem into Dow AgroSciences. The acquisition allowed Dow to enter the South African agrochemicals market and by 2006, Dow's South African holdings consisted of two main companies: Dow AgroSciences and Dow Plastics (Majozi and Veldhuizen, 2015).

Dow has seven offices across South Africa, including four Dow AgroSciences offices

(Gauteng, Sasolburg, Canelands and Paarl). DowAgri SA essentially has a warehousing and distribution role in the country. The firm used to have a plant in Gauteng but it closed down a few years ago.⁵¹ Now DowAgri imports all its products and counts a portfolio of 54 agrochemical products.

DuPont

E. I. du Pont de Nemours and Company, commonly referred to as DuPont, is an American conglomerate headquartered in Wilmington, Delaware, United States. The firm is present in more than 90 countries (DuPont 2016a). In 1998 DuPont, already one of the world's largest chemical companies acquired a 20% stake in Pioneer Hi-Bred, then the world's largest seed company. DuPont purchased the remaining 80% of Pioneer Hi-Bred in 1999 (ACB, 2010 & 2015b), and so the DuPont-Pioneer Hi-Bred (now DuPont Pioneer) agricultural division of the group was established. The group has since then expanded its presence in the food and agricultural sector, with the acquisition in 2011 of Danish-based Danisco, thus "forming a global leader in nutrition and health and industrial biosciences" (DuPont, 2016a) and in 2012 it acquired from Bunge full ownership of the Solae joint venture, a soy-based ingredients company. In 2015, DuPont completed the separation of its Performance Chemicals segment through the spin-off of the Chemours Company (DuPont, 2016a).

DuPont Pioneer is the group's developer and supplier of seeds and plant genetics (Dupont, 2016b). DuPont Pioneer has since the late 1990s extended its network across the continent and is now present in the following countries: Angola, Kenya, Egypt, Malawi, Mozambique, Nigeria, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. It has research stations in Egypt, Kenya and South Africa (DuPont Pioneer, 2016a).

DuPont Pioneer's operations in South Africa started in 1992, with headquarters in Centurion. The firm has a research station in Delmas (Mpumalanga) and a production station in Rosslyn (Gauteng)

50. Telephonic interview, Benjamin Cloete, Business Development Manager – Northern Region: AgroSciences Southern Africa (Pty) Ltd, 30 January 2017

51. Ibid.

(DuPont Pioneer, 2016a). In 2012 DuPont Pioneer acquired the South African seed company, Pannar. It appears that Stark Ayres, which was a Pannar subsidiary and a major company in the horticultural seed sector in South Africa, was spun off and now operates as a subsidiary of the Plennegy Group, a South African company.⁵²

DuPont's agrochemical portfolio counts 62 products (DuPont, 2016c) and its leading crop protection sales are insecticides (45% of sales in 2015), followed by herbicides and fungicides (Agrow, 2016b).

In terms of seeds, DuPont Pioneer focuses on the following crops: maize, soybeans, sorghum, sunflower, alfalfa, canola, wheat, rice, cotton, pearl millet and mustard seed, as well as forage additives; its focus crops in South Africa are maize, soybean and sorghum. It also offers seed treatment for sorghum, maize and soybean (DuPont Pioneer, 2016b).

As indicated earlier, DuPont Pioneer's South African portfolio of seeds is one of the biggest. It includes a total of 439 maize varieties (of which 173 are non-GM hybrids, 263 are GMOs and three are open-pollinated). According to data on the National Variety List, its seed portfolio also includes 42 types of soybean, 22 wheat varieties, 140 other agronomic crops and 28 forage crops (see Table 2).

Where does the transaction stand now?

DuPont and the Dow Chemical Co. announced in December 2015 they will merge into a single company with a market capitalization of \$130 billion, before splitting into three separate businesses, namely an agriculture company, a material science company and a speciality product company (DowDuPont, 2016a).

In February 2016 the merging applicants came forth with the structure of the intended independent agricultural company, "a leading global pure-play agriculture company that unites the seeds and crop protection businesses" (DowDuPont, 2016b) formed from Dow AgroSciences,

DuPont Crop Protection, and Pioneer, DuPont's seed business (Seeking Alpha 2016). This agricultural company will be headquartered in Wilmington, Delaware.

The merger applicants' main rationale for the merger is to cut down costs to increase profit, as bluntly put by the firms' CEOs (New York Post, 2017a). The Dow-DuPont "merger of giants" pamphlet flags how the transaction, described as "highly synergistic" (DowDuPont, 2016a) is expected to result in "run-rate cost synergies" (read cost savings) of approximately US\$3 billion, which are projected to create approximately US\$30 billion of "market value" - read profit for shareholders (Delaware Online 2016). It also points out that this merger would lead to US\$1 billion in "growth synergies" (DowDuPont 2016a), an obscure term that partly implies that spending in R&D will drop - as publicly conceded by Dow and DuPont executives - to the tune of around US\$300 million (Wall Street Journal. 2017).

Despite the explicit drop in R&D expenditure, the firms still contend that the merger will benefit consumers and customers by providing greater innovation and choice. This they say, will be allowed by bringing new products to market faster by combining Dow's biotechnology expertise with DuPont's wide range of corn and soybean genetics (Wall Street Journal, 2017).

This was the moot point for the EU Commission, which was reported to have issued one of the longest charge sheets of objections in its history (Wall Street Journal, 2017). When Dow and DuPont first notified the EU Commission of their merger application in June 2015, the Commission rebuffed their commitments to address preliminary concerns, which led to the launch in August 2016 of an in-depth investigation to understand the merger's potential impact on competition in Europe's agriculture markets ("Phase II").

At the core of the EU regulator's concern was the fact that the merger will entail the loss of a major competitor with significant research capacity. Key concerns in particular

52. <http://www.plennegy.co.za/>

pertained to an erosion of innovation in the markets for herbicides for crops including cereals, beets and oilseed rape, as well as insecticides, nematicides and fungicides for chewing insects (Wall Street Journal, 2017). In the seed sector, a key concern raised was also that the companies will have fewer incentives to license the gene editing technologies they have developed (EU Competition Commission, 2016). Another undisclosed source cited in the New York Post extrapolated on the issue that the drop in crop protection research will lead to a reduction of global yields. Despite all these concerns, the divestments required by the EU essentially pertained to the firms' pesticides and R&D businesses. It is reported that Dow will sell two acid co-polymer manufacturing plants, as well as a contract with a third party through which it buys ionomers, and that the firm had already found a buyer in South Korea's SK Innovation. Analysts expressed surprise at the fact that seed assets remained untouched (there was expectation that Dow would be required to divest its corn seeds business) and that in this respect the divestments required were smaller than originally expected (Reuters 2017c).

With so much confidentiality about the proposed merger in South Africa, it is difficult to anticipate what the direct implication of the Dow-DuPont deal will be on the agricultural economy. In the US the economic implications of the merger are quite significant: Dow already plans to suppress 2,500 jobs and 8% of its Michigan workforce and DuPont is reported to be planning to retrench 1,700 workers in Delaware, in preparation for the merger (EcoWatch, 2016). As mentioned the CCSA has not raised a public interest issue. This implies that the regulator assumes the country will not be affected in terms of employment.

Box 6: The Dow-DuPont merger in South Africa

The merger application between Dow and DuPont is still with the CCSA. The file was submitted to the South African regulatory body in May 2016 and the Commission reports that the investigation is now complete. No decision has been made on the merger as yet, as the Commission is awaiting the response of the parties with regards to the remedial measures to overcome the areas of concern raised by the Commission. These pertain to the seed sector – more specifically sunflower seeds – and insecticides.⁵³ The proposed merger did not raise any public interest issue. There is no specific time frame given for the completion of the case. The CCSA's lead investigator of this merger application said it is a "large merger"⁵⁴ so we are not pressed for time". Whilst the case is still open, third parties can approach the CCSA with any concerns they may have about the anti-trust implications of the proposed merger.⁵⁵

The Bayer-Monsanto merger

Bayer, one of the world's largest agrochemical companies, made a bid for Monsanto, the world's largest seed company, in 2016. Monsanto shareholders accepted the bid for US\$66 billion in December 2016. If the merger is approved by commission authorities in more than 30 countries, the new Bayer-Monsanto will be the world's largest seed and agrochemical company.

Bayer has an extensive agrochemical portfolio in South Africa, while Monsanto operates in both seed and agrochemicals, particularly herbicides. Most importantly, South Africa's core agricultural markets of maize and soya are dominated by Monsanto's GM traits, which are licensed out to other companies for use. For more detail on this merger and the implications

53. As both firms are not only agrochemical giants but also global actors in plastics, performance materials and chemicals, infrastructure and automotive solutions (which will be bundled under the future "material science" company) and nutrition and health, industrial biosciences, protective solutions, electronics and communications and electronic materials (the future "speciality products" company), the CCSA is also investigating the following markets: industrial plastics and food texturizer (PMC to be precise).

54. According to the CCSA thresholds, a large transaction relates to any merger that translates into combined revenues or combined asset value, whichever is the biggest, exceeding R6.6 billion.

55. Telephonic interview, Gilberto Biaciuna: CCSA's lead investigator for the Dow-DuPont merger application, 26 January 2017

Table 4: Summary of global agrochemical and seed portfolios of merger contestants

	Agrochemicals	Seed
Monsanto	Insecticides, fungicides, herbicides, most notably Roundup. Other brands are Bullet, Harness, Guardian Max, Monitor.	Maize, cotton and oilseeds (soybeans and canola) – hybrids and genetically modified. Also vegetable seeds.
Bayer	Insecticides, fungicides, herbicides, and seed growth products.	Cotton, oilseed (rape/canola) and rice – hybrids and genetically modified and vegetable seeds. Plans to expand into soya and wheat seed.
Syngenta	Fungicides, herbicides, insecticides and seed treatment, adjuvants and plant growth regulators.	Cereals (especially wheat and white maize), legumes and oilseeds (especially soybean and sunflower) – hybrids and genetically modified. Sugarcane, fruit and vegetable (especially potatoes).
ADAMA (ChemChina)	Non-patented fungicides, herbicides, insecticides, adjuvants and plant growth regulators.	None.
DuPont Pioneer	Insecticides (45% of sales in 2015), followed by herbicides and fungicides (Agrow, 2016b).	Maize, soybeans (hybrids and genetically modified) wheat, canola, sunflower, alfalfa and sorghum.
Dow AgroSciences	Herbicides, which account for 60% of sales, followed by insecticides and fungicides (Agrow, 2016b).	Biggest sellers are maize, followed by soybeans (hybrids and genetically modified), oilseeds and cotton (Agrow 2016b).

for smallholder farmers in South Africa in particular, see the recent report (ACB, 2017a) and ACB's submission to the CCSA (2017b).

The merger was lodged with the CCSA on 7 February 2017. It is considered an intermediate merger and therefore the CCSA has just 60 days to review the merger and make a decision.

What does control by three companies, rather than six, really mean?

In this section we aim first to understand better what is driving these mergers, and what such mergers entail, should they be (all or partly) approved in terms of the

global and South African agricultural and food context. Put in other words, what is the difference between a global seed and agrochemical system dominated by six MNCs and a system dominated by three?

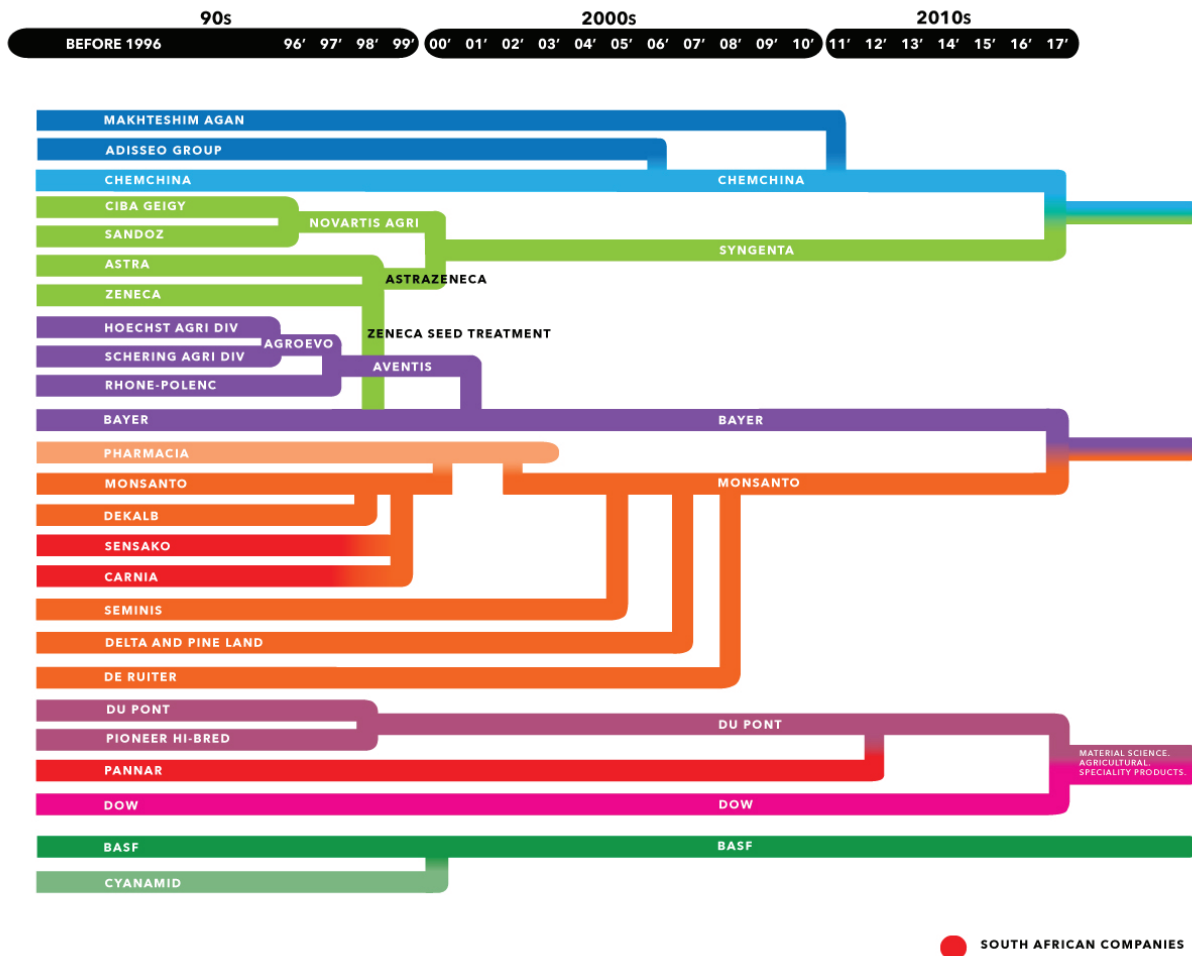
There are several analytical layers one can place on the meaning of these mergers and their synchronicity. As reported by industry analysts, what is most worrying is the synchronicity of the three mergers. It is only when the third round of mergers was announced that the public started raising concerns over global food security.⁵⁶

What are the drivers of these mergers?

There is no single factor that can be isolated to explain these mergers. The traditional arguments put forward by the merging applicants concern the need to expand market share to compete effectively, and to save costs in the context of a downturn

56. Telephonic interview, Pat Mooney, Executive Director: ETC Group, 30 January 2017

TIMELINE OF MERGERS AND ACQUISITIONS



in the sector. In the case of China, the impetus to expand into the global seed and agrochemical sectors seems to be driven by the need to ensure a more secure food future. And in the case of ChemChina, the weak state of the seed market offered an opening for it to expand its global footprint.⁵⁷ In this section we attempt to explore the dominant narrative and then discuss more cryptic drivers that reveal a lot in terms of where this concentration trend is heading.

Increasing profit margins for shareholders?

Economies of scale are a way of saving costs, but tremendous savings in tax also forms a critical driver of these mergers. In the Bayer-

Monsanto deal, what is also at stake is “tax inversion” that Monsanto would benefit from by moving its headquarters to Europe. In the US, Monsanto pays between 28% and 31% in taxes, whereas European companies are paying closer to 15% (ETC Group, 2015). As the “merger of equals” between Dow Chemical and DuPont was first announced in 2015, industry analysts commented on how the tax-free treatment of the new entity’s spin-offs was indeed a key driver of the merger. Mergers of equals are, in fact, a rare occurrence and the firms’ tax savings specifically hinge on their transaction being structured as a merger of equals, which requires companies of the same size

57. Ibid.

and scope willing to negotiate it (Reuters, 2015).⁵⁸ Although the merging parties plan to restructure their business by creating three distinct entities, the argument would be that this wouldn't entail any change of control, as further testified by the fact that the two firms have many shareholders in common (see Box 9).

Keeping shareholders happy is an obvious although often-muted argument, although Andrew Liveris and Ed Breen, CEOs of Dow and DuPont, have been very overt about the profit associated with the merger of equals. They are themselves expected to earn US\$80 million personally from the merger (Delaware Online, 2016).

Seeking out innovation and research synergies?

The merging parties reiterate that consolidation is required to improve R&D.⁵⁹ In a meeting held in September 2016 in camera between the merging applicants (apart from ChemChina) and the US Senate's Judiciary Committee, the MNCs argued that the mergers between leaders in crop protection (DuPont and Bayer) and leaders in traits (Dow and Monsanto) simply offered the perfect matches (USA Today, 2016b).

If we extrapolate, it implies that, through these mergers, some firms can access patents that they wouldn't otherwise have access to and which have constrained their market expansion. The example of Monsanto illustrates this point. There is growing evidence that the products that have built the Monsanto brand and made it the seed and pesticide behemoth it is today are becoming senescent or defective. The ETC Group (2015) argues that 85% of the seed and agrochemical products indeed fall into that category. If we follow the reasoning that industry bodies are exploring new technological avenues beyond the old GM technology (GM corn and soybean

seeds/traits combined accounted for 55% of Monsanto's total sales in 2013), and that globally Roundup is failing to protect crops from weeds because of rising glyphosate resistance (UCS, 2013) (glyphosate-based weed killers accounted for about a third of Monsanto's earnings in 2014), it can be argued that as its technologies come off patent, Monsanto needs a new, fresh and diverse source of herbicide products that are still under patent.⁶⁰ This case was made already when Monsanto coveted Syngenta (Terazono, 2015), which would indeed have been their preferred partner. In this instance merging thus becomes a way of prolonging the life of aging technologies and the assumption that full access to technologies that were restricted through exclusive ownership by a competitor, is receivable. In a similar manner, ChemChina's interest in Syngenta has a lot to do with the need to access breakthrough technologies that will help it propel its market share further, as conceded by Ren Jianxin, ChemChina's President and General Manager (MultiWatch, 2016).

It can, however, be counter-argued that the merger contestants needn't necessarily merge to access each other's technologies. Analysts have uncovered oligopolistic behaviour among the Big Six that seem to indicate that these firms in fact extensively cooperate on the R&D front. Howard (2015) shows how the Big Six have entered into cross-licensing agreements to access transgenic traits and which typically prohibit the entry of new entrants. He gives the example of Smartstax corn, which includes eight different transgenic traits as a result of agreements between Monsanto and Dow. But all firms seem to have been crossing their traits. For instance in 2009 Monsanto and Bayer cross-licensed their herbicide tolerance traits in oil seed rape (canola) (Roundup Ready and Liberty Link), and Dow and Syngenta signed a cross-

58. In a standard merger scenario, under section 355 of the US Internal Revenue Code, companies that have been through a change of control would be liable to pay taxes on their subsequent spin offs - but spin-offs are tax free if the merger does not result in a formal change of control" (Reuters, 2015).

59. James Collins, who heads DuPont's agriculture unit was reported to say: "Dow and DuPont both have strong positions in different parts of the agriculture inputs market, but each needs additional capabilities to compete effectively" (USA Today, 2016a).

60. As explained by the ACB (2009), glyphosate, the key active ingredient in Round Up, came off patent in 2001. But even after the ingredient entered the generic market, Monsanto kept its dominance in global glyphosate sales, and in fact the firm generates the majority of its sales from active ingredients that have lost their patent protection. Hence its inclination to also "manage" (read "control") the post patent area (see Box 7).

Box 7: What happens when biotech crops and agro-chemicals come off patent?

The first patents on first generation biotech crop traits and crop protection technologies have been coming off patent. Patents on the first commercial biotechnology events expired in 2014. Between 2014 and 2020 only a handful of event patents will expire, but the current number of patents on commercial products is expected to increase significantly after 2020 (AgAccord, 2017). The MNCs that are the world's leading firms in transgenic manipulation warn that the future benefits of generic biotech crops are jeopardised by the onerous burden of “unjustifiable” regulatory regimes (for example, the Cartagena Protocol on Biosafety, and seed certification laws, etc.) that require the periodic re-registration (every three to five years) of biotech seeds for commercial cultivation and for food, feed and processing – independent of patent status. Re-registration requires ongoing regulatory support after patent expiration. The materials that are used to prepare for authorisations are proprietary and, therefore, even if the patent has expired, control over this proprietary information (studies, dossiers, data, submissions for approval, etc.) gives the original patent holder continuing power to ask for compensation and payment for these materials that are required to use the GM event (AgAccord, 2013:2). To respond to this, companies have devised private sector contracts that will ultimately “manage the transition to a seed market that includes off-patent biotechnology events”, so as to “ensure commodity trade is not disrupted in key international export markets”.⁶¹ The deal, which was originally drafted by Monsanto encompasses two agreements: 1) The Generic Event Marketability and Access Agreement (GEMAA), which has been operational since November 2012 and which has 10 signatories (all the Big Six except for Syngenta) (AgAccord 2015); and 2) the Data Use and Compensation Agreement (DUCA) (AgAccord, 2013), which has not been activated for lack of signatories.

When it comes to agrochemicals, patent holders have three different means to extend IP over their registered ingredients, namely:

- Supplementary Protection Certificates (SPC): A protection system put in place by the EU in 1993 granting applicants an additional patent protection period of no less than five years;
- Data Protection: There is a 10-year long data protection period in Europe, which can be extended to longer than the basic patent protection period;
- Extended Mixture Patent Protection: When a product comes off patent, the IP holder would often mix the said product with other product to extend the protection period, as an active ingredient of mixture product covered by patent protection entails that its mixture product is also covered by patent protection. Combined with the SPC, this strategy allows MNCs “to continue their capture of market via mixture products even after coming off patent, as a blockage to the competition from generic companies” (Xie, 2015).

licensing agreement to access each other's maize traits (ACB, 2009). This practice is tantamount to what is dubbed “non-merger mergers” (Bryant et al., 2016), although these cross-licencing agreements do come at a cost. If these firms merge, patents and technologies are pooled and become readily accessible within the merged entity.

MNCs have also managed to circumvent the patent protection issue through many other tactics, which include exclusive monopoly patents to swap proprietary traits and technologies; R&D alliances (ex. BASF and Monsanto) or patent litigation truces (for example, DuPont and Monsanto brokered a truce in 2013 over a patent issue

(Reuters, 2013; Wall Street Journal, 2013; ETC Group, 2015). Another tactic the Big Six have devised pertains to the so-called “post-patent” regulatory regime (see Box 7).

Pushing for global responses to global issues...

At a more substantial level, the merger contestants are also building an argument around the issue of food insecurity in the context of climate change. They contend that the impetus to feed the world requires unrestrained global systems and they are also strongly pushing their “climate smart technologies”, which are, in fact, purely conventional agricultural practices in disguise (ACB, 2015b). So put simply, these

61. <http://www.agaccord.org/?p=about>

Box 8: Off-patent seeds and agrochemical active ingredients

Information on off-patent seeds and agrochemical ingredients is difficult to come by. For seeds, the GEMAA (see Box 7 above) is a source to consult on the topic but remains limited as it depends on signatories' willingness to upload information on patent expiration. The AgAccord website indicates that, to date, the following notices of patent expiration have been received (AgAccord, 2017): Monsanto's 40-3-2 soybean and Monsanto's Mon 810 corn.

For pesticides, according to industry analysts, in 2013 proprietary patented pesticides represented 25% of total market value, proprietary off-patent pesticides⁶² accounted for 30% and generic pesticides accounted for 45% (Xie, 2015). Glyphosate, the active ingredient patented by Monsanto in the 1970s as an active ingredient for the 'Round Up' herbicide went off-patent in 2000 (Glyphosate, 2013). Between 2015 and 2019, 28 kinds of active ingredients (10 herbicides, 12 fungicides, 5 insecticides and one safener) have/will come off patent in the EU. Details on the ingredients whose patents expire in the said period are captured in Table 5. Suffice to say, for the firms that are of interest to us (the market value figures given are for 2013), that:

- Bayer: Nine products will/have come off patent allowing for a total market value of US\$1.57 billion;
- BASF: Three products will/have come off patent (US\$1.09 billion);
- Syngenta: Two products will come off patent (US\$785 million);
- Dow Agro will have one product come off-patent in 2017 (US\$255 million) (Xie 2015).

firms are trying these mergers, first, on the basis of the precedent mergers that took place in the sector, and second, because they feel they can sway governments to abide by their corporate reasoning. And here the "global firms for global issues" argument seems to meet the "too big to fail" argument.

...or getting ready for the next (agricultural) world order...

These are all reasons that seem to play a part in the current wave of merger applications. But these reasons are also perhaps just symptomatic responses to a much greater undercurrent that analysts have difficulty grappling with. Could it be that these mammoth firms, for all their might, not only want to conquer the world but also fear for their own survival? The sequencing of these merger announcements hints at a certain jitteriness; the firms have, in fact, been reported to concede that once Monsanto started the hunt, all the other Big Six had to embark on the rummaging.⁶³ This domino effect phenomenon seems to indicate that the six majors are positioning themselves

– maybe against other giants in the sector, such as the agricultural implements sector.

The sentiment is that the "hardware boys" could be the next acquirers of the seed/ agrochemical "Big Three" mammoths. Here is why. The capital power of the farm implements firms by far exceeds that of the agrochemical and seed sector; the sales of each of the Big Six are half or less than those of Deere & Co.'s 2016 sales of US\$27.9 billion (Forbes, 2016). But seeds and agrochemicals are also a subset that forms part of the greater package offered by the "machinery majors" (ETC Group, 2015). Their products all land in the big Deere and Co. box, which also holds the comparative advantage of knowing what is being harvested.⁶⁴ And "maybe by 2020 – RoboCrop seed/pesticide/ fertiliser drilling machines will rule the field" (ETC Group, 2015:2). By that time aging technologies, such as transgenic crops would have been superseded by new GMO technologies, such as CRISPR genome-editing products and synthetic biology, which are cheaper and quicker to develop.⁶⁵

62. Proprietary off-patent product is defined as a "product whose patented active ingredient expires but the terminal formulated product is still protected due to its patented technology, GM crop-affiliated nature or active ingredient-associated mixture" (AgroPages 2015).

63. Telephonic interview, Pat Mooney, Executive Director: ETC Group, 30 January 2017

64. Ibid.

65. Ibid.

Box 9: BlackRock – a hand in every pie?

BlackRock Inc. is an investment and asset management firm that was founded in 1988 under the umbrella of The Blackstone Group (BlackRock, 2016a). BlackRock is active in 30 countries. It boasts that it “is trusted to manage more money than any other investment firm” (BlackRock, 2016b). BlackRock is genuinely at the top of the global financial emporium – in 2006 it acquired Merrill Lynch Investment Managers and in 2009 it acquired Barclays Global Investors, “giving the firm additional active, index and exchange traded fund capabilities through iShares” Group (BlackRock, 2016a).

The firm’s growth is difficult to grasp; in 1992 the capital assets under its management amounted to US\$17 billion. By 2016, BlackRock’s assets under management totalled US\$5.1 trillion across “equity, fixed income, cash management, alternative investment, real estate and advisory strategies” (BlackRock, 2016b). The firm also specialised in financial advice through its Financial Markets Advisory (FMA), which advises both private and public markets, that is to say companies, pension funds, foundations, and public institutions, including governments.

BlackRock seems to have a hand in all the mega-mergers underway. It is the fourth largest shareholder of Dow Chemical and DuPont stocks, behind the Vanguard Group Inc., State Street Global Advisors and Capital World Investors (Reuters, 2015). All except Capital World were ranked in the world’s five biggest asset managers in 2015 (Investopedia, 2016).

BlackRock is also Syngenta’s major shareholder, and the group stands to make half a billion Swiss francs from the sale of its Syngenta shares to ChemChina (MultiWatch, 2016:23). But the ramifications go even further. In 2007, US private equity fund, The Blackstone Group invested US\$600 million in China National Bluestar Group, a ChemChina subsidiary, for a 20% equity stake. This was the first international investor in a state-owned enterprise in China. China National Bluestar Group conducts worldwide R&D on chemicals for the agricultural and industrial sectors, including operations in the US (ChemChina, 2016e). BlackRock is also a major investor in Bayer, holding 7% of the group’s shares, and it also holds 5.75% of Monsanto’s shares, making it the latter’s second largest shareholder (Süddeutsche Zeitung, 2016). And to round off the story, BlackRock also holds equity in BASF, with 1.6% equity held by the BlackRock Asset Management Deutschland AG and 1.39% held by BlackRock Fund Advisors (4-traders, 2017). Interestingly, the Vanguard group, another financial behemoth, is Monsanto’s biggest shareholder, Bayer’s second biggest shareholder (Süddeutsche Zeitung, 2016) and BASF’s third largest shareholder (4-traders, 2017).

...that will be dominated by the financial world?

The sceptical reader might find discussions about the dominance of the world’s food systems by not six but three multinationals, or by a single conglomerate steered by Deere & Co a little far-fetched. But, in reality, this analysis might be too short-sighted. To understand what is really

happening, we need to follow the money...

The Big Six only exist through their shareholding structure. A closer look at the shareholders behind the merging contestants reveals that the world genomics resources may, in fact, rest in the hands of global financial firms, with BlackRock standing out as a very ominous player.

Table 5: Active ingredients to come off-patent in the EU, 2014 and 2019

Table 1 Pesticides to come off-patent in 2015-2019					
Active Ingredient	Company	EU Patent Expiry Date	SPC Maximum Expiry Year	Market value in 2013 (USD million)	Use
Herbicides					
fentrazamide	Bayer CropScience	2014.02.13	-	70	rice
foramsulfuron	Bayer CropScience	2015.04.12	2016	135	corn, turf
topramezone	BASF	2016.02.14	2020	90	corn, turf
penoxsulam	Dow AgroSciences	2017.09.23	2020	255	cereals, rice, turf
orthosulfamuron	ISAGRO	2018.03.09	2023	5	sugarcane, rice
pinoxaden	Syngenta	2019.03.11	2020	400	wheat, barley
metamifop	Dongbu Hannong Chemical	2019.07.24	-	2	rice
tembotrione	Bayer CropScience	2019.09.09	2021	210	corn
thiencarbazone	Bayer CropScience	2020.07.04	2023	-	corn, soybean, wheat, turf
flucetosulfuron	LG Life Sciences	2020.10.12	-	6	turf, rice
Fungicides					
benthiavalicarb	Kumiai Chemical Industry	2015.05.23	-	25	non-crop, vegetables & fruits, potato
pyraclostrobin	BASF	2015.06.21	2016	930	soybean, cereals, corn, non-crop, vegetables & fruits
metalaxyl-M	Syngenta	2015.06.30	-	385	cotton, potato, vegetables & fruits, soybean, sunflower
prothioconazole	Bayer CropScience	2015.11.08	2019	750	cereals, sugarcane
cyflufenamid	Nippon Soda	2015.12.17	2020	8	vegetables & fruits, turf, ornamentals
penthiopyrad	Mitsui Chemical Agro Inc.	2016.04.03	2021	40	vegetables & fruits, turf
fluoxastrobin	Bayer CropScience	2017.01.15	2019	170	cereals, vegetables & fruits, non-crop
metrafenone	BASF	2018.08.18	-	75	cereals, vegetables & fruits, roses
amisulbrom	Nissan Chemical Industry	2018.10.23	2022	15	tomato, potato, grapevines
fluopicolide	Bayer CropScience	2019.02.16	2020	65	vegetables & fruits, potato, tomato, ornamentals
fenpyrazamine	Sumitomo Chemical	2019.04.22	2024	1	vegetables & fruits, soybean, ornamentals
valifenalate	ISAGRO	2019.11.24	-	10	vegetables & fruits, tobacco, ornamentals
Insecticides					
pyridalyl	Sumitomo Chemical	2015.10.12	2020	15	vegetables & fruits, cotton, ornamentals
spirotetramat	Bayer CropScience	2017.07.23	2022	165	non-crop, vegetables & fruits
metofluthrin	Sumitomo Chemical	2019.02.24	-	2	non-crop
flubendiamide	Nihon Nohyaku	2019.11.24	2023	445	vegetables & fruits, cotton, corn, soybean, rice
pyrifluquinazon	Nihon Nohyaku	2020.11.02	-	10	vegetables & fruits, tea, ornamentals
Safener					
cyprosulfamide	Bayer CropScience	2018.09.24	2023	-	corn
Note: Expiry date of some products may be beyond 2019 because of patent extension or some products expired but where patent extensions have resulted in patent expiry in 2015-2019.					

Source: Xie, 2015

Implications of the mega-mergers on South Africa

The primary concerns put forward by regulators and relevant judiciary bodies worldwide are that these mergers might erode competition and lead to a decline in R&D. These are fair concerns but one needs to go much further in attempting to foresee the implications of these mergers. How will they affect the agricultural economy, farmers, and, ultimately, the food base?

Innovation in the sector

The issues raised by regulatory bodies with regards to the mergers that have been filed generally point to the risk of withering R&D in the sector, leading to less innovation and less choice. This is true, as evidenced by McDougall (2013), who found that between 1995 and 2012, the number of pesticide R&D companies globally halved (from 35 companies to 18) and between 2000 and 2012, the number of new active ingredients in the R&D pipeline decreased by 60%.

However we contend that the issue is not that fewer transgenic crops or agrochemicals would be released on the market,⁶⁶ but rather that a shift from the Big Six to the Big Three as a result of these mergers would further entrench R&D towards high-profit proprietary products, as opposed to appropriate products for Africa's and South Africa's farmers. The real challenge for farmers lies in building resilience to climate change, increasing diversity and remaining viable in the context of a very costly input market (ACB, 2017a). By 2013, Monsanto, DuPont, Syngenta, Dow, Bayer and BASF accounted for 76% of total private R&D expenditures in both the seed and agrochemical sectors (ETC Group, 2013). Solberg and Breian (2015) studied the implications of agricultural consolidation in five Nordic countries (from 1950 to the present). Their work shows that this consolidation translated into a decrease in

the number of available cultivars, a shift in focus to crops and hybrids most profitable to companies, and termination of breeding programs for regionally relevant crops. Intellectual property (IP) rights holders will not invest in agronomic and integrated solutions to pests, diseases and climate change if these will not generate large and continuous profits. Their interest lies in deepening solutions requiring the proprietary toxins they hold in their existing chemical portfolios. Should the proposed mergers go through, they will further entrench a research path dependency skewed towards a few crops they are good at producing (maize, soya, cotton), agrochemical inputs, transgenic crops and other proprietary resources that will further lock farmers into a narrow high input model, whilst compromising the resource base of future generations.

Commodity prices

Ultimately, MNCs investing in the seed and agrochemical sector will carry over the cost of their R&D investments into the products that they sell. Fuglie et al. (2012) point out of all input increases US farmers had to deal with from 1990 to 2000, the largest was in crop seed prices, which more than doubled (relative to commodity prices). This increase was partly attributed to the "value of the new seed traits resulting from the research investments made by seed/biotechnology companies" (2012:5).

A study on the drivers of price increase of seeds in the US between 2004 and 2010 attributed the increase to the value added by private seed and biotech companies. An industry analyst reports that between 32% and 74% of the price of seed for maize, soybeans, cotton and sugar beets reflects technology fees or the cost of seed treatment (Fuglie et al., 2012). In South Africa, the fact that GM maize seeds are more expensive than non-GM seeds is common knowledge. The average price of white maize seeds (60,000 kernels/bag) increased by 8.7%, from R1,900 in 2013 to R 2,353 in 2015, while non-GM maize comparatively only increased by 3.1% (DAFF, 2015). This quite

66. In fact this is quite counter-intuitive if we bear in mind that the agrochemical industry's survival rests upon the cyclical release of new chemistry to overcome the issue of resistance build-up.

simply illustrates how transgenic seeds pushed by the MNCs expose farmers, and indirectly consumers, to price increases.

Ultimately these deals will expose smallholder farmers to price shocks and limit the variety of seeds that they access. Consecutive years of surplus harvests in industrialised countries has led to a drop in crop prices and forced farmers to reduce their investments in agricultural inputs (Mendoza 2016). The concentration trend is driven by the need to realise economies of scale and save costs, and the prediction is that once the market “picks up” again, the industry will drive prices up again, exposing farmers to price shocks.

A recent study by Bryant, et al. (2016) assessed the economic impacts of the potential Dow-DuPont and Bayer-Monsanto mergers. They estimate the effects of proposed mergers and acquisitions on mark-ups and market prices on some selected seeds shows a potential price increase of 2.3% for corn, 1.9% for soybeans, and 18.2% for cotton.⁶⁷ As the first two of these commercial crops equally dominate the South African agricultural landscape and as the main seed firms are the same majors as in the US, it is reasonable to assume that similar increments could be expected in South Africa should the mergers go through.

Impacts on commercial and smallholder farmers

Important linkages exist between industry consolidation and rural farming and agriculture. The mergers bring to light long-term issues related to crop access and agricultural innovation (Mendoza, 2016), as well as land ownership patterns that are central to the livelihoods of smallholder farmers.

Hall and Cousins (2015) highlight how “the overall trajectory of agrarian change in South Africa over the past two decades has seen consolidation of the hegemony of large-scale commercial farming and corporate

agri-business within agricultural value chains”. The dominance of the country’s agricultural production by large commercial farms is on the increase. Liebenberg (2013:28) indicates just 0.6% of commercial farming units (237 units) accounted for a third of income in 2007. This can be compared with the top 5% of farms accounting for 10% of income in 1993. Also using 2007 Agricultural Census data, Kirsten (2011) indicated that 57% of commercial farmers had an annual gross income of R500,000 or less, and just 7% of all commercial farm units had a gross income of R5 million or more. This concentration of ownership and control of land is tied in with the bio-tech and high-tech production systems described in this paper and illustrates clearly the failure of land redistribution in the country, for which a meagre 0.5% of the national budget has been allocated over the past two decades (Hall and Cousins, 2015). One could argue that the consolidation of South Africa’s agricultural land⁶⁸ forms the perfect canvas to accommodate the incremental “Big Data” approach to farming, which essentially cuts small-scale farmers out of the picture.

It is tautological to point out that any firm controlling inputs into production – and in the agricultural sector, this entails soil data, climate and weather patterns, historical data on crop yields, seed, agrochemicals and fertilisers, and (precision farming) machinery – will gain tremendous control over the market and sector and therefore exercise tremendous control over farmers by dictating to them what to do rather than provide services to the farmer (ETC Group, 2015).

This directly ties in with the alienation of farmers from the productive processes. At the time of Pioneer’s acquisition of Pannar, ACB (2012) documented how further corporate concentration in the seed sector – and throughout the agro-food system from input supply to retailing – will exacerbate the existing situation whereby farmers are becoming irreversibly disconnected from breeding processes.

67. Their research finds a 25% chance that price increases would meet or exceed the following values: 2.6% for corn, 2.1% for soybeans, and 20.2% for cotton.

68. In 2016 the South African government announced its intention to set a range of limits on the surface of farm “from a 1,000 hectare ‘small-scale’ farm, up to the largest allowed, at 12,000 hectares” (Reuters, 2016d).

Finally, an overdependence on any one crop or individual seed variety exposes farmers to certain ecological vulnerabilities. Crops can become less resilient to changing climate patterns and soil can more easily deteriorate (ACB, 2017a). Wider agricultural biodiversity can suffer if R&D is oriented towards a few lucrative commercial crops, while other crops with local demand – but without sufficient scale required by these large corporations for investment – are marginalised and even lost.

Food sovereignty

All these points bring us to the fundamental issue, which is the crux of the mega-merger discussion.

As we saw, the risk posed by an exacerbated concentration in the seed and agrochemical sectors has a lot to do with limiting research, innovation and choice. If the mergers are approved, these MNCs will push their research agendas in favour of their “champion crops”. Lianos et al.’s (2016) analysis of the current dynamics in the global seed market, competition law and IP rights underline the strong vulnerability inherent to any disruption in seed supply that may cause a “systemic food shock of a global magnitude”.

It is interesting that when engaging with the Big Six, they all portray themselves as merely being maize seed growers.⁶⁹ They are obviously far more than just maize growers but if we look at what the global seed leaders produce, this statement is disturbingly true. Maize is indisputably the dominant crop at a global level, and this is an aspect that should also make the gatekeepers in charge of our food nervous. In 2015, Syngenta’s top seed sale was maize, which represented 39% of its sales; for DowAgri maize represented 52% of sales that same year (Agrow, 2016b). Monsanto has historically invested a big chunk of its R&D budget in maize (traits researched include primarily yield enhancement, followed by weed and insect control) (Agrow, 2016b). Monsanto is also South Africa’s largest seed company by sales and the leader in the country’s maize production.

As indicated in Figure 4, maize accounts for 60% of South Africa’s commercial seed crops by value. In other words, the food system is worryingly homogeneous. The lack of diversity of the food base makes South Africa very vulnerable in terms of food sovereignty. The recent infestation by fall army worm threatens to decimate South Africa’s staple crop, a situation that is made worse by the dominant mono-cropping production system and lack of diversity in the field. As demonstrated by the ACB (2016b) in previous research, more resources should be invested to diversify the base, including through bolstering the production of drought tolerant grain crops that are indigenous to Africa, such as sorghum, millet, etc. as well as more investment in the “long tail” of lesser crops and varieties that play a very significant role in ensuring a diversity of available food products for consumers.

But further exacerbating the food production issue is a huge agrochemical push on increasingly fragile ecosystems. ChemChina, for instance, is clearly motivated by the need to ensure a secure food base for its growing population and will do so through an industrial agricultural system. MultiWatch warns that if the ChemChina-Syngenta deal goes through, because of the magnitude of the resources that will go into this agrochemical production, “there is a very real and present risk that highly toxic agrochemical substances will be distributed even faster, and that highly problematic agro-genetic engineering technologies will expand ever more rapidly, both in China and across the whole world” (MultiWatch, 2016:24). And what this chemical giant intends to do will be shrouded in secrecy, because once the deal goes through, ChemChina “intends to have the Syngenta shares ... delisted from trading” (Syngenta, 2016c.), meaning that once Syngenta’s share come off the stock exchange, it will be absorbed into the Chinese state-owned company and will publish less information (MultiWatch, 2016).

69. Telephonic interview, Pat Mooney, Executive Director: ETC Group, 30 January 2017

Conclusion

The global consolidation trends in the agricultural sector are mirrored in South Africa, as the country's (as well as the continent's) seed and agrochemical sectors are also dominated by the "Big Six". Our analyses of the listed seed varieties and registered active ingredients shows that the merging firms/Big Six dominate the seed market (DuPont Pioneer and Monsanto) and are major actors in the agrochemicals market (ChemChina through ADAMA, Syngenta, Dow, Bayer, BASF and Monsanto) in South Africa.

It is important to consider the wider implications of these mergers beyond a narrow view of competition in segmented product markets. These include the entrenchment of a dominant technological platform in agricultural inputs, broader impacts on the agro-food system, agricultural biodiversity, input prices for farmers and knock-on effects on food prices, domestic innovation, and implications for just economic transformation and widening the base of productive activity.

The reader, here, is alerted to the forthcoming publication of the International Panel of Experts on sustainable food systems (IPES Food) titled *Concentration, Competition and Bargaining Power in Food Systems*. This paper will assess the state of concentration in agro-food systems, with respect to recent corporate mergers, and the implications for innovation and for building sustainable food systems, and will constitute a valuable complementary read to the current paper.

Importantly, new thinking is required along what constitutes genuine innovation – we need to move away from the perception that innovation can be driven solely by the private sector, as historically MNCs in the agricultural sector have relied heavily on state resources (including in Africa) for their "breakthrough" technologies. The current IP regime stifles innovations than would genuinely benefit those who matter: commercial and small-scale farmers.

The fundamental question is whether further concentration in seed and agrochemical markets will really facilitate South African developmental goals of diversifying the economic base and including smaller producers in systems of innovation and production with adequate support. Concentration makes this not only unlikely, but will work definitively against these goals.

The Commission and our decision makers hold some power over the outcome of these deals. Should the Dow-DuPont and Monsanto/Bayer transactions not be allowed in South Africa, and in other southern economies, they will send strong signals to the shareholding base of these firms, who are likely to become more uncertain about them. And they can, therefore, not only influence the outcome of the transaction globally, but most importantly protect their domestic markets and farmers from the unavoidable price increases that would accompany such mergers.

References

- 155 Competition Commission: Notification to approve with conditions the transaction involving: China 4-traders. 2017. BASF SE (BAS). [Online] Available: <http://www.4-traders.com/BASF-SE-6443227/company/> Accessed: 12 January 2017.
- ACB (African Centre for Biosafety). 2009. Biotechnology, seed and agrochemicals in South Africa. [Online] Available: http://webcache.googleusercontent.com/search?q=cache:sPr_vqJsnA4J:acb.org.za/biotechnology-seed-and-agrochemicals-booklet/+&cd=1&hl=en&ct=clnk&client=firefox-b Accessed: 20 December 2016.
- ACB (African Centre for Biosafety). 2010. Submission to the Competition Commission regarding the proposed acquisition of Pannar Seed by Pioneer Hi-Bred. [Online] Available http://acb.org.za/wp-content/uploads/2015/02/compcom_submission_pioneer_pannar.pdf. Accessed: 19 February 2017.
- ACB (African Centre for Biodiversity). 2015a. The political economy of Africa's burgeoning chemical fertiliser rush. [Online] Available: <https://acb.org.za/fertilizer-report-20140915-4/> Accessed: 15 December 2016.
- ACB (African Centre for Biodiversity). 2015b. The Pioneer/Pannar Seed merger: Deepening structural inequalities in South Africa. [Online] Available: <http://acb.org.za/wp-content/uploads/2015/02/Seed-Merger.pdf>. Accessed: 20 December 2016.
- ACB. 2015c. The expansion of the commercial seed sector in Sub-Saharan Africa: Major players, key issues and trends. [Online] Available: <http://www.acbio.org.za/wp-content/uploads/2015/12/Seed-Sector-Sub-Sahara-report.pdf> Accessed: 22 January 2017.
- ACB (African Centre for Biodiversity). 2016a. For your own good!: The chicanery behind GM non-commercial 'orphan crops' and rice for Africa. [Online] Available: <https://acb.org.za/wp-content/uploads/2016/04/GM-Orphan-Crops-Report.pdf> Accessed: 20 December 2016.
- ACB (African Centre for Biodiversity). 2016b. Transitioning out of GM maize: Towards nutrition security, climate adaptation, agro-ecology and social justice [Online] Available: <http://acb.org.za/wp-content/uploads/2016/10/GM-Maize-report-10-2016.pdf> Accessed: 20 December 2016.
- ACB (African Centre for Biodiversity). 2017a. The Bayer-Monsanto merger: Implications for South Africa's agricultural future. [Online] Available: <http://acb.org.za/the-bayer-monsanto-merger-implications-for-south-africas-agricultural-future-and-its-smallholder-farmers/> Accessed: 20 February 2017.
- ACB (African Centre for Biodiversity). 2017b. Submission to the South African Competition Commission on Bayer Monsanto merger. [Online] Available: <http://acb.org.za/acb-submission-competition-commission-bayer-monsanto-merger/> Accessed: 13 March 2017.
- ACCC (Australian Competition and Consumer Commission). 2016. ACCC will not oppose ChemChina's proposed acquisition of Syngenta. [Online] Available: <https://www.accc.gov.au/media-release/accc-will-not-oppose-chemchina%E2%80%99s-proposed-acquisition-of-syngenta> Accessed: 1 February 2017.
- ADAMA. 2016a. Who we are. [Online] Available: <http://www.adama.com/en/about-adama/company-profile/> Accessed: 9 January 2017.
- ADAMA. 2016b. Our products. [Online] Available: <http://www.adama.com/south-africa/en/products/?page=1&ProductType=Herbicide> Accessed: 10 January 2017.
- Adisseo. 2016. [Online] Available: <http://www.adisseo.com/> Accessed: 10 January 2017.
- AgAccord. 2013. The Data Use and Compensation Agreement (DUCA) [Online] Available: <http://www.agaccord.org/?p=DUCA> Accessed: 20 January 2017.
- AgAccord. 2015. The Generic Event Marketability and Access Agreement (GEMAA) [Online] Available: <http://www.agaccord.org/?p=GEMAA> Accessed: 20 January 2017.
- AgAccord. 2017. About the AgAccord. [Online] Available: <http://www.agaccord.org/?p=about> Accessed: 6 March 2017.
- AGCO. 2017. Our Brands. [Online] Available: <http://www.agcocorp.com/brands.html> Accessed: 19 February 2017.
- Agra. 2017a. Sanonda shareholders meet on ADAMA "reverse merger". [Online] Available: <https://www.agra-net.com/agra/agrow/companies-business/sanonda-shareholders-meet-on-adama-reverse-merger--1.htm> Accessed: 17 February 2017.
- Agra. 2017b. Monsanto sees R&D gains from Bayer acquisition. [Online] Available: <https://www.agra-net.com/agra/agrow/companies-business/monsanto-sees-rd-gains-from-bayer-acquisition-537742.htm> Accessed: 15 February 2017.
- Agrihandbook. 2016. Crop protection. [Online] Available: <http://www.agrihandbook.co.za/index.php/book/inputs/crop-protection>. Accessed: 1 November 2016.
- Agroprofessional.com. 2013. Global commercial seeds market expected to reach US\$52 billion. [Online] Available: <http://www.agroprofessional.com/news/Global-commercial-seeds-market-expected-to-reach-52-billion-215529841.html> Accessed: 10 December 2016.
- Agrow. 2016a. Top 20 crop protection companies in 2016. [Online] Available: <https://store.agra-net.com/agrowreports/agrow-top-20-crop-protection-companies-2016.html> Accessed: 10 February 2017.
- Agrow. 2016b. Crop protection markets in Africa in 2016. [Online] Available: <https://store.agra-net.com/awca16.html> Accessed: 10 February 2017.
- AGWeb. 2016. Monsanto, Bayer execs make their case to soybean farmers. [Online] Available: <http://www.agweb.com/article/monsanto-bayer-execs-make-their-case-to-soybean-farmers-naa-susan-luke-naa-susan-skiles-luke/>. Accessed: 6 February 2017.
- AGWeb. 2017. Syngenta takeover hits another snag. Posted on 14 February 2017. [Online] Available: <http://www.agweb.com/article/syngenta-takeover-hits-another-snap-blmg/> Accessed: 6 February 2017.

- Alessi, C. 2016. EU regulations contributing to consolidation in biotech, agrochemicals industry. Published on 20 September 2016 for the Genetic Literacy Project. [Online] Available: <https://www.geneticliteracyproject.org/2016/09/20/eu-regulations-contributing-consolidation-biotech-agrochemicals-industries/> Accessed: 6 February 2017.
- AVCASA. 2016. List of remedies. [Online] Available: <http://www.avcasa.co.za/index.php?layout=edit&id=3> Accessed: 10 January 2017.
- BASF. 2017. BASF and the European Space Agency to develop digital services for farmers. Posted on 10 February 2017. [Online] Available: <https://www.basf.com/en/company/news-and-media/news-releases/2017/02/p-17-127.html> Accessed: 18 February 2017.
- BPIA (Biological Products Industry Alliance). 2017. Biopesticides market overview. [Online] Available: www.bpia.org/market-overview/ Accessed: 10 February 2017.
- BlackRock. 2016a. Our history. [Online] Available: <https://www.BlackRock.com/corporate/en-us/about-us/BlackRock-history> Accessed: 10 January 2017.
- BlackRock. 2016b. About BlackRock. [Online] Available: <https://www.BlackRock.com/au/individual/about-BlackRock> Accessed: 10 January 2017.
- Bloomberg. 2014. Syngenta to open second Africa research center in Kenya in 2016. [Online] Available: <https://www.bloomberg.com/news/articles/2014-05-08/syngenta-to-open-second-africa-research-center-in-kenya-in-2016> Accessed: 2 January 2017.
- Bloomberg. 2015a. DuPont to cut 1,700 Delaware-based jobs ahead of Dow merger. [Online] Available: <http://www.bloomberg.com/news/articles/2015-12-29/dupont-to-cut-1-700-delaware-based-jobs-ahead-of-dow-merger>. Accessed: 1 November 2016.
- Bloomberg. 2015b. Dow Chemical-DuPont agree to combine in merger of equals. [Online] Available: <http://www.bloomberg.com/news/articles/2015-12-11/dow-chemical-dupont-agree-to-combine-in-merger-of-equals>. Accessed: 1 November 2016.
- Bloomberg. 2016. Potash Corp and Agrium to merge, creating fertilizer giant. [Online] Available: <http://www.bloomberg.com/news/articles/2016-09-12/agrium-potash-corp-to-combine-in-fertilizer-merger-of-equals>. Accessed: 1 November 2016.
- Broad Insititue. 2017. Quesitons and answers about CRISPR. [Online] Available: <https://www.broadinstitute.org/what-broad/areas-focus/project-spotlight/questions-and-answers-about-crispr> Accessed: 8 January 2017.
- Bruulsema, T.W., Heffer, P., Welch, R.M., Cakmak, I. and Moran, K. 2012. *Fertilizing crops to improve human health: A scientific review*. Volume 1: Food and Nutrition Security IPNI, Norcross, GA, USA; IFA, Paris, France, May 2012. Copyright 2012 IPNI/IFA.
- Bryant, H., Maisashvili, A., Outlaw, J. and Richardson, J. 2016. Effects of proposed mergers and acquisitions among biotechnology firms on seed prices. Research conducted for the Agricultural & Food Policy Center, Department of Agricultural Economics, Texas. Working Paper 16-2. September 2016. [Online] Available: <http://www.afpc.tamu.edu/> Accessed: 8 January 2017.
- ChemChina. 2016a. About us. [Online] Available: http://www.chemchina.com/en/gywm/A6016web_1.htm Accessed: 9 January 2017.
- ChemChina. 2016b. Introduction. [Online] Available: http://www.chemchina.com/en/gywm/jtjj/A601601web_1.htm Accessed: 9 January 2017.
- ChemChina. 2016c. Agrochemicals. [Online] Available: http://www.chemchina.com/en/cpyfw/ywbk/nyhx/A60180104web_1.htm Accessed: 9 January 2017.
- ChemChina. 2016d. Overseas development. [Online] Available: http://www.chemchina.com/en/gjyw/whfz/A601701web_1.htm Accessed: 9 January 2017.
- ChemChina. 2016e. ChemChina in US. [Online] Available: http://www.chemchina.com/en/gjyw/in/A601705web_1.htm Accessed: 9 January 2017.
- China Africa Research Initiative. 2013. China Africa Ec. and Trade Coop. White Paper 2013. [Online] Available: <http://www.chinaafricarealstory.com/2013/09/china-africa-economic-and-trade.html> Accessed: 19 January 2017.
- CIMMYT (International Maize and Wheat Improvement Center). 2016. DuPont Pioneer and CIMMYT form CRISPR-Cas public/private partnership. Published 28 September 2017[Online] Available: http://www.cimmyt.org/press_release/dupont-pioneer-and-cimmyt-form-crispr-cas-publicprivate-partnership/ Accessed: 14 January 2017.
- CNH Industrial. 2017. Our History. [Online] Available: http://www.cnhindustrial.com/en-us/know_us/our_history/Pages/default.aspx Accessed: 19 February 2017.
- Competition Commission. 2016. Statement on the decisions of the Competition Commission. [Online] Available: <http://www.compcom.co.za/wp-content/uploads/2016/01/Commission-Statement-22-September-2016-Final.pdf>. Accessed: 15 November 2016.
- Competition Commission. 2017. Notification to approve with conditions the transaction involving: China National Agrochemical Corporation and Syngenta, Case number: 2016JUN0322. Notice 155 of 2017. [Online] Available: https://www.greengazette.co.za/notices/competition-commission-notification-to-approve-with-conditions-the-transaction-involving-china-national-agrochemical-corporation-and-syngeta-ag_20170224-GGN-40645-00155.pdf Accessed: 2 March 2017.
- CTA (Technical Centre for Agricultural and Rural Cooperation). 2015. Developing the African seed industry. [Online] Available: <http://www.cta.int/en/article/2015-03-16/developing-the-african-seed-industry.html>. Accessed: 10 November 2016.

- DAFF (Department of Agriculture, Forestry and Fisheries). 2016. South African varietal list as maintained by the registrar of plant improvement: Seed crops. November 2016. [Online] Available: http://www.nda.agric.za/doaDev/sideMenu/plantProduction/doc/SA%20Varietal%20List%20SEED_Nov%202016_2.pdf. Accessed: 9 January 2017.
- De Schutter, O. 2010. Addressing concentration in food supply chains: The role of competition law in tackling the abuse of buyer power. Briefing note 03 December 2010.
- Delaware Online. 2016. Dow, DuPont CEOs could earn \$80 million after merger. Published 3 March 2016. [Online] Available: <http://www.delawareonline.com/story/money/2016/03/03/dow-dupont-ceos-could-earn-80m-after-merger/81280910/> Accessed: 10 January 2017.
- Dow. 2015. Dow reports fourth quarter and full-year results. [Online] Available: <http://www.dow.com/en-us/investor-relations/financial-reporting/earnings/q4-2015> Accessed: 21 February 2017.
- Dow. 2016a. Dow and DuPont statement regarding Phase II Review by European Commission. [Online] Available: <http://www.dow.com/en-us/news/press-releases/dow-and-dupont-statement-regarding-phase-ii-review-by-european-commission> Accessed: 19 January 2017.
- Dow. 2016b. Our company. [Online] Available: <http://www.dow.com/en-us/about-dow/our-company> Accessed: 29 January 2017.
- DowAgroscience. 2016. Innovation. [Online] Available: <http://www.dowagro.com/en-us/innovation> Accessed: 29 January 2017.
- DowDupont. 2016a. Merger fact sheet. [Online] Available: <http://www.dowdupontunlockingvalue.com/> Accessed: 30 January 2017.
- DowDupont. 2016b. Dupont, Dow announce site structure of intended independent agriculture company. [Online] Available: <http://www.dowdupontunlockingvalue.com/news/dupont-dow-announce-site-structure-intended-independent-agriculture-company> Accessed: 30 January 2017.
- DuPont Pioneer. 2016a. Middle East and Africa. [Online] Available: <https://www.pioneer.com/home/site/about/business/contact-us/middle-east-africa/> Accessed: 19 February 2017.
- DuPont Pioneer. 2016b. South African crop production products. [Online] Available: http://duponttools.force.com/ppf?lang=EN_ZA&country=ZAF&level0=Industries&level1=Agriculture&level2=Crop%20Production Accessed: 19 February 2017.
- DuPont. 2016a. Our history. [Online] Available: <http://www.dupont.com/corporate-functions/our-company/dupont-history.html> Accessed: 19 February 2017.
- DuPont. 2016b. DuPont Pioneer. [Online] Available: <http://www.dupont.com/corporate-functions/our-company/businesses/pioneer.html> Accessed: 19 February 2017.
- DuPont. 2016c. DuPont crop protection. [Online] Available: http://duponttools.force.com/ppf?lang=EN_US&country=USA&level0=Categories&level1=Crop%20Protection Accessed: 19 February 2017.
- Ecwatch. 2016. Trump picks Dow chemical chief to head American Manufacturing Council [Online] Available: <http://www.ecowatch.com/trump-andrew-liveris-2148620854.html> Accessed: 28 January 2017.
- Esterhuizen, D. 2016. Agricultural biotechnology annual: Biotechnology in South Africa. United States Department of Agriculture Foreign Information Service Global Agricultural Network. [Online] Available: <https://www.fas.usda.gov/data/south-africa-agricultural-biotechnology-annual-o> Accessed: 6 February 2017.
- ETC Group. 2012. Synthetic Biology: 10 key points for delegates. Briefing for COP11. [Online] Available: <http://www.etcgroup.org/content/synthetic-biology-10-key-points-delegates>. Accessed: 2 February 2017.
- ETC Group. 2013. Gene Giants Seek 'Philanthropopoly', released 7 March 2013. [Online] Available: <http://www.etcgroup.org/content/Ecomm-gene-giantsseek-philanthropopoly>. Accessed: 1 February 2017.
- ETC Group. 2015. Breaking bad: Big Ag Mega-mergers in play – Dow + DuPont in the pocket? Next: Demonsanto? ETC Group. [Online] Available: <http://www.etcgroup.org/content/breaking-bad-big-ag-mega-mergers-play>. Accessed: 2 February 2017.
- ETC Group. 2016a. Software vs. Hardware vs. Nowhere: Deere & Co. is becoming 'Monsanto in a box'. ETC Group's year-end update on global agriculture's mega-mergers. Submitted 13 December 2016. [Online] Available: <http://www.etcgroup.org/content/deere-co-becoming-monsanto-box> Accessed: 26 January 2017.
- ETC Group. 2016b. The Monsanto-Bayer tie-up is just one of seven: Mega-mergers and big data domination threaten seeds and food security. [Online] Available: <http://www.etcgroup.org/content/monsanto-bayer-tie-just-one-seven-mega-mergers-and-big-data-domination-threaten-seeds-food>. Accessed: 1 November 2016.
- European Competition Commission. 2016. Commission to investigate impact of Dow and DuPont merger on farming. Press release published 11 August 2016. [Online] Available: http://europa.eu/rapid/press-release_IP-16-2784_en.htm Accessed: 4 January 2017.
- Export. 2016. South Africa – Agricultural Sector. [Online] Available: <https://www.export.gov/article?id=South-Africa-agricultural-equipment> Accessed: 2 January 2017.
- Farmers Weekly. 2016. Agri wheels: Make way for the driverless tractor. 30 September 2016 edition.
- Fernandez-Cornejo, J. and Schimelpfenning, D. 2004. Have seed industry changes affected research effort? *Amber Waves* 2(1): 14–19.
- Forbes. 2016. Deere & Company. Market update as of May 2016. [Online] Available: <http://www.forbes.com/companies/john-deere/> Accessed: 20 January 2017.
- Foreign Ministry of the People's Republic of China. 2015. State Councilor Yang Jiechi's Interview with Independent News & Media South Africa. 10 October 2015. [Online] Available: http://www.fmprc.gov.cn/mfa_eng/zxxx_662805/t1304815.shtml Accessed: 4 February 2017.
- Fortune. 2016. Basf is weighing a counterbid for dupont. [online] available: <http://fortune.com/2016/03/07/basf-is-weighing-a-counterbid-for-dupont/> accessed: 20 January 2017. Accessed: 20 January 2017.

- Fuglie, K., Haisey, P., King, J. and Schimmelpfennig, D. 2012. Rising Concentration in agricultural input industries influences new farm technologies. USDA ERS Report. [Online] Available: <http://www.ers.usda.gov/amber-waves/2012-december/rising-concentration-in-agricultural-input-industries-influences-new-technologies.aspx#V37C5fkrJhF> Accessed: 16 January 2017.
- Glyphosate. 2013. History of glyphosate. [Online] Available: <http://www.glyphosate.eu/glyphosate-basics/history-glyphosate> Accessed: 2 March 2017.
- Gouse, M. 2014. *Assessing the value of glyphosate in the South African agricultural sector*. Department of Agricultural Economics, Extension and Rural Development, University of Pretoria.
- Hall, R. and Cousins, B. 2015. Commercial farming and agribusiness in South Africa and their changing roles in Africa's agro-food system. Paper delivered on 20–21 April 2015, as part of the International Conference: Rural transformations and food systems: The BRICS and agrarian change in the global South, BRICS Initiative for Critical Agrarian Studies (BICAS). PLAAS, University of the Western Cape. Bellville.
- Howard, P.H. 2009. Visualizing consolidation in the global seed industry: 1996–2008. *Sustainability* 1(4): 1266–1287.
- Howard, P.H. 2015. Intellectual property and consolidation in the seed industry. *Crop Science* 55(6): 2489–2495.
- Howard, P.H. 2016. *Concentration and power in the food system*. Bloomsbury Publishing.
- Investopedia. 2016. The 5 biggest asset managers at the end of 2015 (BLK). Published 16 January 2016. [Online] Available: <http://www.investopedia.com/articles/investing/012716/5-biggest-asset-managers-end-2015-blk.asp> Accessed: 16 January 2017.
- IPEF-Food. 2016. From uniformity to diversity: A paradigm shift from industrial agriculture to diversified agroecological systems. International Panel of Experts on Sustainable Food Systems. [Online] Available: www.ipes-food.org. Accessed: 10 February 2017.
- Kirsten, J. 2011. Most SA farmers are small scale. *Farmers' Weekly*, 23 Sept, p.38.
- Kirsten, J., Stander, R. and Haankuku, C. 2010. Measuring Private Research & Innovation in South Asia & Sub-Saharan Africa. A South Africa Country Report. [Online] Available: <https://www.asti.cgiar.org/pdf/SouthAfrica-Note.pdf> Accessed: 10 December 2016.
- Lianos, O., Katalevsky, D., & Ivanov, A. 2016. The Global Seed Market, Competition Law and Intellectual Property Rights: Untying the Gordian Knot. Centre for Law, Economics and Society (CLES) Research Paper Series 2/2016. [Online] Available: <http://docplayer.net/27467947-Centre-for-law-economics-and-society-research-paper-series-2-2016.html> Accessed: 10 February 2017.
- Liebenberg, F. 2013. South African agricultural production, productivity and research performance in the 20th century. PhD thesis, University of Pretoria.
- Majazi, T. & Veldhuizen, P. 2015. The Chemicals Industry in South Africa. Publication of the American Institute of Chemical Engineers (AIChE). [Online] Available: <http://www.aiche.org/cep> Accessed: 10 December 2016.
- Markets and Markets. 2016. Seed market worth US\$113 billion by 2022. [Online] Available: <http://www.marketsandmarkets.com/PressReleases/seed.asp> Accessed: 10 December 2016.
- Markets and Markets. 2017. Animal genetics market by type (canine, poultry, porcine, bovine) genetic material [semen (bovine porcine equine) embryo (bovine equine) testing services (DNA testing, DNA typing, genetic disease testing)] – Global Forecast to 2021. [Online] Available: <http://www.marketsandmarkets.com/PressReleases/animal-genetic.asp> Accessed: 10 February 2017.
- Market Watch. 2017. DuPont pushes back Dow deal closing. Published on 24 January 2017. [Online] Available: <http://www.marketwatch.com/story/dupont-pushes-back-dow-deal-closing-2017-01-24>. Accessed: 10 February 2017.
- Mazid, S., Kalida, J.C., Rajkhowa, R.C. 2011. A review on the use of biopesticides in insect pest management. *International Journal of Scientific Advanced Technology* 1:169–178.
- McDougall, P. 2013. R&D trends for chemical crop protection products and the position of the European Market: A consultancy study undertaken for ECPA, September 2013. [Online] Available: http://www.ecpa.eu/files/attachments/R_and_D_study_2013_v_1.8_webVersion_Final.pdf Accessed: 12 February 2017.
- Mendoza, N. 2016. Will big agriculture mergers impact smallholder farmers? Published 29 September 2016 on Devex Impact. [Online] Available: <https://www.devex.com/news/will-big-agriculture-mergers-impact-smallholder-farmers-88820> Accessed: 2 February 2017.
- MultiWatch. 2016. March against Syngenta: Monsanto's Swiss twin unmasked. [Online] Available: <http://marchagainstsingenta.org/wp-content/uploads/2016/10/MultiWatch-20161012-eBook-Appetizer.pdf> Accessed: 12 February 2017.
- N+1 Swiss Capital. 2016. Fairness opinion on the public tender offer by China National Chemical Corporation to acquire Syngenta AG. [Online] Available: https://www.syngenta-growth.com/en/shareholder-information/Edition_8 Accessed: 14 January 2017.
- New York Post. 2017a. DuPont-Dow merger faces stiff EU resistance. Posted on 15 January 2017. [Online] Available: <http://nypost.com/2017/01/15/dupont-dow-merger-faces-stiff-eu-resistance/> Accessed: 4 February 2017.
- New York Post. 2017b. DuPont-Dow merger may signal how EU will handle Bayer-Monsanto. [Online] Available: <http://nypost.com/2017/01/25/dupont-dow-merger-may-signal-how-eu-will-handle-bayer-monsanto/> Accessed: 4 February 2017.
- News24. 2017. Zuma's full State of the Nation address. Posted 9 February 2017. [Online] Available: <http://www.news24.com/SouthAfrica/News/read-zumas-full-sona-address-20170209> Accessed: 14 February 2017.
- Nimbkar, C & van Arendonk, J. 2010 Recent trends in the global organization of animal breeding. Paper for the International Technical Expert Workshop held at Wageningen, The Netherlands on 8–10 December 2010. "Exploring the need for specific measures for access and benefit sharing of animal genetic resources for food and agriculture".

- Philpott, T. 2016. Robots Are Growing Tons of Our Food. Here's the Creepy Part. It's not what you think. Written for *MotherJones*. Sept. Oct 2016 issue. [Online] Available: <http://www.motherjones.com/environment/2016/09/monsanto-farming-precision-agriculture> Accessed: 12 January 2017.
- Plastics News Europe. 2017. Dow Chemical and DuPont have offered to sell part of DuPont's crop protection business. *European Rubber Journal* Published: 14 February 2017. [Online] Available: <http://www.european-rubber-journal.com/2017/02/14/dow-dupont-agree-divest-businesses-win-merger-approval/> Accessed: 22 February 2017.
- PR Newswire. 2015. South Africa agrochemicals market – by type, application and market shares, forecasts and trends (2015–2020). 7 October, PR Newswire. [Online] Available: <http://www.prnewswire.com/news-releases/south-africaagrochemicals-market--by-type-application-and-geography-market> Accessed: 10 January 2017.
- Rainer Breitling, R., Takano, E., Gardner, T.S. 2015. Judging synthetic biology risks. *Science*, Science 09 Jan 2015, Vol. 347, Issue 6218, pp. 107, DOI: 10.1126/science.aaa5253. [Online] Available: <http://science.sciencemag.org/content/347/6218/107.full> Accessed: 16 February 2017.
- Report Buyer. 2016. Agrochemicals market – mergers and acquisitions – global trends and outlook by deal type, by segment and by region: overview. [Online] Available: <https://www.reportbuyer.com/product/3839378/agrochemicals-market-mergers-and-acquisitions-global-trends-and-outlook-by-deal-type-by-segment-and-byregion.html>. Accessed: 10 November 2016.
- Reuters. 2013. Monsanto, DuPont strike \$1.75 billion licensing deal, end lawsuits. Article written by Carey Gillam, 26 March 2013. [Online] Available: www.reuters.com/article/us-monsanto-dupont-gmo-idUSBREg2PoIK20130326 Accessed: 22 January 2017.
- Reuters. 2015. Dow, DuPont eye big tax savings in rare merger of equals. Published 15 December 2015. [Online] Available: <http://www.reuters.com/article/us-dow-m-a-tax-idUSKBNoTY01K20151215> Accessed: 9 January 2017.
- Reuters. 2016a. Agrium and Potash Corp are merging to make a giant fertilizing company. *Fortune*. September 12, 2016. [Online] Available: <http://fortune.com/2016/09/12/agrium-potash-corp-merger/> Accessed: 9 January 2017.
- Reuters. 2016b. Fertilizer majors Potash and Agrium to merge, face tough scrutiny. Reuters. September 12, 2016. [Online] Available: <http://www.reuters.com/article/us-agrium-m-a-potashcorp-idUSKCN11oZo> Accessed: 9 January 2017.
- Reuters. 2016c. China's Sinochem chief dismisses ChemChina merger reports as 'rumour'. Posted 16 January 2017. [Online] Available: <http://www.reuters.com/article/chemchina-ma-sinochem-idUSL4N1F63PK> Accessed: 22 January 2017.
- Reuters. 2016d. South Africa to limit farm sizes to speed land redistribution. Published 21 May 2016. [Online] Available: <http://www.reuters.com/article/us-safrica-landrights-reform-idUSKCN0yCoGJI> Accessed: 2 March 2017.
- Reuters. 2017a. ChemChina, Syngenta submit minor concessions to EU watchdog: Sources. Posted 10 January 2017. [Online] Available: <http://www.reuters.com/article/us-syngenta-ag-m-a-chemchina-idUSKBN14UoDD> Accessed: 19 January 2017.
- Reuters. 2017b. Chemchina seeks US anti-trust approval for Syngenta deal [Online] Available: <http://www.reuters.com/article/us-chemchina-syngenta-us-idUSKBN154oY4> Accessed: 22 January 2017.
- Reuters. 2017c. Asset sales plan secures EU backing for \$130 billion Dow, Dupont merger. Posted 27 March 2017. [Online] available: <http://www.reuters.com/article/us-du-pont-m-a-dow-eu-iduskbn16y16o> Accessed: 29 March 2017.
- SAAMA (South African Agricultural Machinery Association). 2009. Tractor and combine harvester sales [Online] Available: <http://www.saama.co.za/saama/saamstat.htm> Accessed: 19 January 2017.
- Schimmelpfenning, D.E., Pray, C.E. and Brennan, M.F. 2004. The impact of seed industry concentration on innovation: A study of U.S. biotech market leaders. *Agricultural Economics* 30:157–167.
- Seedworld. 2016a. Is the race for GMO traits over? [Online] Available: <http://seedworld.com/race-gmo-traits> . Accessed: 10 January 2017.
- Seedworld.com 2016b. Hydrobio and Monsanto work to increase sustainability of seed production. [Online] Available: <http://seedworld.com/hydrobio-and-monsanto-work-to-increase-sustainability-of-seed-production/>. Accessed: 10 January 2017.
- Seedworld.com 2017a. The Climate Corporation unveils R&D pipeline. [Online] Availability: <http://seedworld.com/climate-corporation-unveils-rd-pipeline/>. Accessed: 10 January 2017.
- SeedWorld. 2017b. Monsanto reaches new licensing agreement on crispr technology. [Online] Available: <http://seedworld.com/monsanto-reaches-new-licensing-agreement-on-crispr-technology/> Accessed: 10 January 2017.
- Seeking Alpha. 2016. Dow and DuPont, Bayer and Monsanto or Syngenta – Which will succeed? Published 17 November 2016. [Online] Available: <http://seekingalpha.com/article/4024476-dow-dupont-bayer-monsanto-syngenta-will-succeed> Accessed: 22 January 2017.
- Seeking Alpha. 2017. Syngenta active on report of EU deal green light. Published 2 February 2017. [Online] Available: <http://seekingalpha.com/news/3240076-syngenta-active-report-eu-deal-green-light> Accessed: 22 February 2017.
- Solberg, S.Ø. and Breian, L. 2015. Commercial cultivars and farmers' access to crop diversity: A case study from the Nordic region. *Agricultural and Food Science*, Vol. 24: 150–163.
- Statista. 2015. Dow Chemical's R&D expenditure as a share of revenue from 2005 to 2016. [Online] Available: <https://www.statista.com/statistics/267334/dow-chemicals-rundd-expenditure-as-a-percent-of-revenue/> Accessed: 22 February 2017.

- Stucke, M.E. and Grunes, A.P. 2016. *An antitrust review of the Bayer-Monsanto Merger*. Washington D.C.: The Konkurrenz Group.
- Süddeutsche Zeitung. 2016. Bei Bayer und Monsanto reden auf beiden Seiten dieselben Investoren mit. Published 21 September 2016. [Online] Available: <http://www.sueddeutsche.de/wirtschaft/monsanto-und-bayer-bei-bayer-und-monsanto-reden-auf-beiden-seiten-dieselben-investoren-mit-1.3170377> Accessed: 6 February 2017.
- Syngenta. 2016a. Syngenta South africa. [Online] Available: <https://www.syngenta.co.za/> Accessed: 1 February 2017.
- Syngenta. 2016b. Vegetables. [Online] Available: <https://www.syngenta.co.za/vegetables> Accessed: 1 February 2017.
- Syngenta. 2016c. Oil seeds. [Online] Available: <https://www.syngenta.co.za/oilseeds>. Accessed: 29 January 2017.
- Syngenta. 2016d. Research and development. [Online] Available: <https://www.syngenta.co.za/research-development> Accessed: 1 February 2017.
- Syngenta. 2016e. potato pack [Online] Available: <https://www.syngenta.co.za/potatopacktm> Accessed: 29 January 2017.
- Syngenta. 2016f. ChemChina and Syngenta receive clearance from the Committee on Foreign Investment in the United States (CFIUS). Press release 22 August 2016. [Online] Available: http://www.chemchina.com/en/press/press/A604001web_1.htm Accessed: 1 February 2017.
- TASAI (The African Seed Access Index). 2015. The South African Brief. TASAI. [Online] Available: <http://tasai.org/wp-content/uploads/SOUTH-AFRICA-BRIEF-final.pdf>. Accessed: 12 January 2017.
- Terazono, E. 2015. Herbicide diversity drives Monsanto's bid for Syngenta, Financial Times, 2 June 2015. [Online] Available: <https://www.ft.com/content/gbcdaa3c-0604-11e5-b676-00144feabdco> Accessed: 12 February 2017.
- The Climate Corporation. 2017. The Climate Corporation unveils most robust R&D pipeline in digital agriculture. Published 5 January 2017 [Online] Available: <https://www.climate.com/company/press-releases/the-climate-corporation-unveils-most-robust-rnd-pipeline-in-digital-agriculture/> Accessed: 19 January 2017.
- UCS (Union of Concerned Scientists) USA. 2013. The rise of superweeds – and what to do about it. December 2013: http://www.ucsusa.org/sites/default/files/legacy/assets/documents/food_and_agriculture/rise-of-superweeds.pdf. Accessed: 7 February 2017.
- United States Department of Justice. 2016. Justice Department sues to block deere's acquisition of precision planting. Press Release August 31, 2016. [Online] Available: <https://www.justice.gov/opa/pr/justice-department-sues-block-deere-s-acquisition-precision-planting> Accessed: 1 February 2017.
- USA Today. 2016a. Agriculture executives defend merger 'tsunami'. Posted on 16 September 2016. [Online] Available: <http://www.usatoday.com/story/money/nation-now/2016/09/20/agriculture-executives-defend-merger/90741422/> Accessed: 7 February 2017.
- USA Today. 2016b. Missing information halts Europe's review of DuPont deal. Posted on September 9, 2016. [Online] Available: <http://www.usatoday.com/story/money/nation-now/2016/09/09/european-union-dow-dupont-merger/90113862/> Accessed: 7 February 2017.
- Wall Street Journal. 2017. Markets: Probe focuses on new company's ability to make weed-killing sprays and sturdier plants. Written by Natalia Drozdiak, Jacob Bunge. Published 17 January 2017. [Online] Available: <http://www.wsj.com/articles/dow-dupont-merger-probe-hinges-on-innovation-concerns-1484648516> Accessed: 12 February 2017.
- Xie, C. 2015. Four billion dollars' worth of pesticides to come off patent in 5 years. [Online] Available: <http://news.agropages.com/News/NewsDetail---14166.htm> Accessed: 2 March 2017.



PO Box 29170, Melville 2109, South Africa
www.acbio.org.za